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ABSTRACT

This curriculum guide in agricultural equipment and mechanics is one of 10 guides developed as part of a vocational project stressing agribusiness, natural resources, and environmental protection. The scope of this guide includes two occupational subgroups: agricultural power service and repair, and the service of agricultural equipment. It is meant as an aid to all who are involved in the curriculum planning phases prior to classroom instruction. Each unit has seven elements to be used for developing specific curriculum and curriculum materials: unit concept, student performance objectives, instructional areas, examples of learning activities, examples of evaluation processes, instructional materials or equipment, and references. Appendixes list recommended materials and equipment, additional references, and selected professional and technical societies. (Author/JC)

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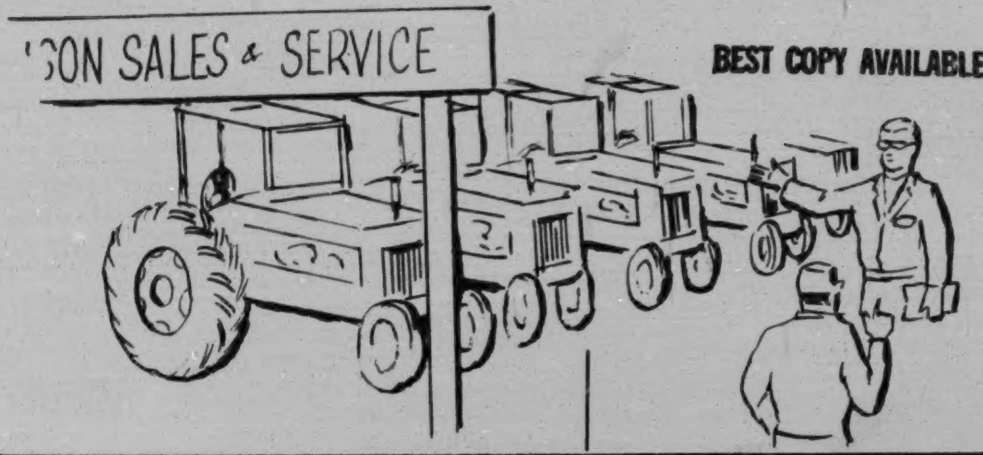

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Career Preparation in

AGRICULTURAL EQUIPMENT AND MECHANICS

A Curriculum Guide for High School Vocational Agriculture

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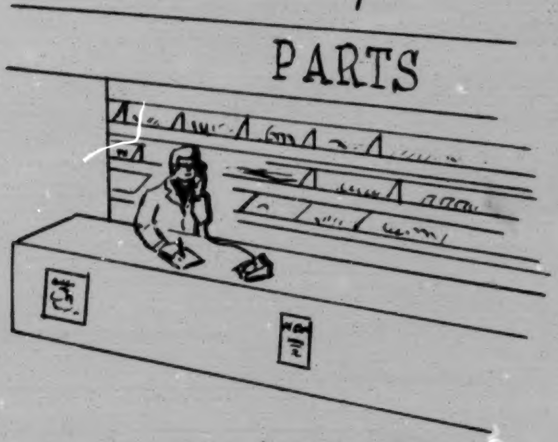

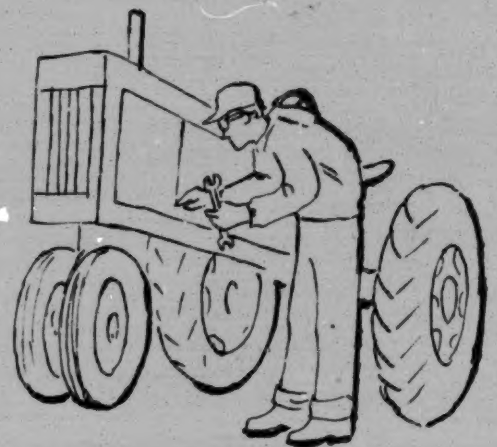

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CAREER EXPLORATION IN AGRIBUSINESS, NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION: A CURRICULUM GUIDE FOR GRADES 7-9.

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CAREER PREPARATION IN ENVIRONMENTAL PROTECTION: A CURRICULUM GUIDE FOR HIGH SCHOOL VOCATIONAL AGRICULTURE.

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FOREWORD

THIS SUGGESTED CURRICULUM GUIDE IN AGRICULTURAL EQUIPMENT AND MECHANICS IS ONE OF TEN GUIDES DEVELOPED UNDER THE DIRECTION OF THE OHIO CAREER EDUCATION AND CURRICULUM MANAGEMENT LABORATORY, DEPARTMENT OF AGRICULTURAL EDUCATION, COLLEGE OF AGRICULTURE, THE OHIO STATE UNIVERSITY, AS A PART OF THE PROJECT ENTITLED "CURRICULUM DEVELOPMENT BASIC TO THE TRAINING OF INDIVIDUALS FOR EMPLOYMENT IN AGRIBUSINESS, NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION." THE PROJECT WAS FUNDED UNDER A CONTRACT WITH THE BUREAU OF OCCUPATIONAL AND ADULT EDUCATION, U.S. OFFICE OF EDUCATION.

THE PROJECT GREW OUT OF THE NEED TO IDENTIFY THE EDUCATIONAL EXPERIENCES MOST APPROPRIATE FOR CAREER DEVELOPMENT IN AGRIBUSINESS, NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION. EDUCATORS WERE LACKING ADEQUATE AND ACCURATE INFORMATION FOR THE CAREER AWARENESS AND EXPLORATION STAGES OF THE CAREER DEVELOPMENT PROCESS CONCERNING THE AGRIBUSINESS COMPLEX.

THE AGRIBUSINESS COMPLEX ALSO HAD SEVERAL EMERGING PROGRAM AREAS WHERE OCCUPATIONAL COMPETENCIES AND THE RELATED CURRICULUM HAD NOT BEEN WELL DEFINED AT THE VOCATIONAL PREPARATION LEVEL. THESE CONDITIONS CAUSED APPROPRIATE CAREER DEVELOPMENT PROGRAMS TO BE LACKING OR INEFFECTIVE AT ALL LEVELS, LEADING UP TO AND INCLUDING VOCATIONAL EDUCATION, BECAUSE GUIDANCE IN MATERIALS AND PROCESSES OF CONDUCTING THESE PROGRAMS WERE NOT ADEQUATELY DEVELOPED.

IN MAY OF 1971, AGRICULTURAL LEADERS REPRESENTING STATE SUPERVISORS, TEACHER EDUCATORS, CLASSROOM TEACHERS AND THE AGRICULTURAL BUSINESS AND INDUSTRIAL COMMUNITY MET IN DENVER, COLORADO, TO DISCUSS THE CHANGING NATURE OF THE FIELD. THERE WAS GENERAL AGREEMENT THAT THE DEVELOPING EMPHASIS ON AGRIBUSINESS, NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CALLED FOR MAJOR CURRICULUM CHANGES AND DEVELOPMENT OF NEW CURRICULA, WITH CHANGES IN THE PREPARATION OF AGRICULTURAL EDUCATION PERSONNEL AT THE SAME TIME.

THE PURPOSES OF THIS PROJECT WERE: (1) TO DEVELOP APPROPRIATE CURRICULUM GUIDES IN AGRIBUSINESS, NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION WHICH PROVIDE A COORDINATED EDUCATIONAL PROGRAM, INCLUDING CAREER AWARENESS, CAREER EXPLORATION AND PREPARATION FOR A CLUSTER OF OCCUPATIONS; (2 [illegible] ACQUAINT EDUCATIONAL LEADERSHIP IN ALL STATES WITH THE CURRICULUM MATERIALS FROM THIS PROJECT AND PROMOTE THEIR USE; AND (3) TO DISSEMINATE COPIES OF THE CURRICULUM MATERIALS TO LEADERS OF EACH STATE.

ACKNOWLEDGEMENTS

THIS CURRICULUM GUIDE WAS DEVELOPED BY ED YODER, CURRICULUM SPECIALIST ASSOCIATE, DEPARTMENT OF AGRICULTURAL EDUCATION, THE OHIO STATE UNIVERSITY, WITH ASSISTANCE FROM THE STAFF OF THE OHIO CAREER EDUCATION AND CURRICULUM MANAGEMENT LABORATORY IN AGRICULTURAL EDUCATION AND THE PROJECT ADVISORY COMMITTEES FOR ASSISTANCE IN PLANNING AND REVIEWING THE GUIDES. APPRECIATION IS ALSO EXTENDED TO DR. ELIZABETH J. SIMPSON, BRANCH CHIEF, CURRICULUM DEVELOPMENT BRANCH, DIVISION OF RESEARCH AND DEMONSTRATION, BUREAU OF OCCUPATIONAL AND ADULT EDUCATION AND TO THE LATE DR. PHILLIP TESKE, PROJECT OFFICER, U.S. OFFICE OF EDUCATION, BUREAU OF OCCUPATIONAL AND ADULT EDUCATION FOR THEIR DIRECTION DURING THE PREPARATION OF THIS GUIDE. ALSO, GRATITUDE IS EXTENDED TO THE TEACHERS AND INDUSTRY PERSONNEL WHO HAVE GIVEN TIME FROM THEIR JOBS TO ASSIST IN A CRITIQUE OF THE GUIDES.

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AGRICULTURAL EQUIPMENT AND MECHANICS

THE USE OF THIS CURRICULUM GUIDE

THERE IS LESS THAN FULL AGREEMENT ON JUST WHAT CONSTITUTES A PARTICULAR TYPE OF CURRICULUM DOCUMENT. THE CURRICULUM GUIDE IS NO EXCEPTION. THE FOLLOWING IS NOT MEANT AS AN EFFORT TO DEBATE CURRICULUM TERMINOLOGY FURTHER, BUT RATHER TO CLARIFY HOW THIS DOCUMENT CAN BE USED MORE EFFECTIVELY FOR ITS INTENDED PURPOSE.

ENTITLED A CURRICULUM GUIDE, IT IS DESIGNED TO ANSWER THE MORE BASIC QUESTIONS OF CURRICULUM PLANNING AND DEVELOPMENT - WHAT SHOULD BE TAUGHT AND, TO SOME DEGREE, HOW AND WITH WHAT RESOURCES? IT IS NOT INTENDED TO TEACH FROM NOR TO BE USED AS INSTRUCTIONAL MATERIAL IN THE CLASSROOM BY EITHER TEACHER OR STUDENTS.

IT IS MEANT AS AN AID TO ALL WHO ARE INVOLVED IN THE CURRICULUM PLANNING PHASES PRIOR TO CLASSROOM INSTRUCTION. FOR ADMINISTRATORS AND OTHERS WHO MUST MAKE DECISIONS CONCERNING FACILITIES OR EQUIPMENT, THERE ARE GUIDELINES TO BOTH SPECIFICATIONS AND OVERALL COST RANGES. FOR GUIDANCE COUNSELORS OR OTHERS WORKING WITH STUDENTS ON CAREER DECISIONS, INFORMATION IS PROVIDED CONCERNING OCCUPATIONS AND THE TYPE OF COMPETENCIES AND CHARACTERISTICS NEEDED BY THE WORKERS FOR THESE OCCUPATIONS. FOR THE CURRICULUM SPECIALIST, TEACHER EDUCATOR, STATE SUPERVISOR OR OTHERS RESPONSIBLE FOR DETERMINING INSTRUCTIONAL CONTENT AND PREPARING TEACHERS TO CONDUCT INSTRUCTIONAL PROGRAMS, THE GUIDE DEFINES THE NEEDS OF THE STUDENTS IN TERMS OF TERMINAL PERFORMANCES. ALL OTHER ASPECTS OF CURRICULUM CONTENT, TEACHING PROCESSES AND INSTRUCTIONAL RESOURCES ARE BASED UPON THE TERMINAL PERFORMANCE OBJECTIVES FOR THE STUDENTS.

THE SCOPE OF THE GUIDE INCLUDES TWO OCCUPATIONAL SUBGROUPS WITHIN THE AGRICULTURAL EQUIPMENT AND MECHANICS AREA. THESE ARE CONSISTENT WITH AND CODED AS DEFINED IN THE STANDARD TERMINOLOGY FOR CURRICULUM AND INSTRUCTION IN LOCAL AND STATE SCHOOL SYSTEMS. THE OVERALL AREA OF AGRICULTURAL EQUIPMENT AND MECHANICS IS GIVEN THE DESIGNATION 01.03 00 00 00. THE OCCUPATIONAL SUBGROUPS HAVE THE FOLLOWING DESIGNATIONS:

AGRICULTURAL POWER SERVICE AND REPAIR	01.03 01 00 00
ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF AGRICULTURAL EQUIPMENT.	01.03 01 00 00

THE OCCUPATIONS CONSIDERED IN THESE TWO SUBGROUPS ARE LIMITED TO THOSE ON THE CAREER LADDER FOR WHICH HIGH SCHOOL VOCATIONAL INSTRUCTION IS EITHER NECESSARY OR SIGNIFICANTLY DESIRABLE. THE UNITS WITHIN THE GUIDES ARE BUILT UPON MINIMUM LEVEL OF COMPETENCIES FOR ENTRY LEVEL JOBS. HOWEVER, IT IS ASSUMED THAT, EVEN THOUGH STUDENTS MUST BEGIN AT THIS ENTRY LEVEL JOB, MANY WILL SOON BE STRIVING TO ADVANCE. WHENEVER THE EMPLOYEE IS PRESENTED WITH OTHER DESIRABLE JOB OPPORTUNITIES, IT IS INTENDED THAT HIS VOCATIONAL INSTRUCTION WILL HELP HIM MASTER EARLY JOB OPPORTUNITY ADVANCES IN AN EFFICIENT MANNER.

SOME STATES HAVE PROVIDED THAT APPROXIMATELY 2,000 HOURS BE USED DURING THE JUNIOR AND SENIOR YEARS FOR INSTRUCTION, LABORATORY AND COOPERATIVE ON-THE-JOB EXPERIENCE IN A SPECIALIZED AGRICULTURAL EQUIPMENT AND MECHANICS PROGRAM. WHILE THIS GUIDE MAY NOT COVER ALL INSTRUCTIONAL SEQUENCES WHICH MAY BE POSSIBLE, THERE IS LIKELY TO BE MORE INCLUDED IN THIS GUIDE THAN WOULD BE USED IN ANY ONE PROGRAM INVOLVING 2,000 HOURS. IT IS INTENDED THAT THE USERS OF THIS GUIDE WILL SELECT THOSE INSTRUCTIONAL AREAS TO BUILD AN INSTRUCTIONAL PACKAGE WHICH MOST APPROPRIATELY MEETS THE STUDENTS' NEEDS IN THAT STATE OR LOCALITY.

BECAUSE MANY AGRICULTURAL EQUIPMENT AND MECHANICS PROGRAMS ACROSS THE COUNTRY ARE SIMILAR OR, AT LEAST, HAVE MANY COMMON AREAS IN THE CURRICULUM, CONSIDERABLE REDUNDANCY OF EFFORT OCCURS AS THESE PROGRAMS ARE PLANNED AND DEVELOPED. IN PREPARING THIS GUIDE, A MAJOR CONCERN HAS BEEN TO IDENTIFY THOSE PERFORMANCE OBJECTIVES WHICH ARE COMMON TO ALL OR TO A LARGE PROPORTION OF THE PROGRAMS. THOSE WHICH ARE ONLY APPROPRIATE TO LIMITED LOCALITIES HAVE NOT BEEN INCLUDED.

IT IS INTENDED THAT THE OBJECTIVES STATED IN THIS GUIDE WOULD SAVE TIME AND EFFORT FOR STATE PERSONNEL WHO HAVE THE RESPONSIBILITY FOR DEFINING THE OCCUPATIONAL COMPETENCIES IN AGRICULTURAL EQUIPMENT AND MECHANICS.

ONCE THE OBJECTIVES FROM THE GUIDE WHICH ARE COMMON TO THE STATE CURRICULUM NEEDS ARE DEFINED, THEY COULD BE USED TO FACILITATE STATING MORE SPECIFIC LEVELS OF OBJECTIVES. OR, IF OTHER OBJECTIVES ARE MORE APPROPRIATE, THEY COULD BE SUBSTITUTED FOR THOSE PRESENTED AS STATE OR LOCAL CONDITIONS WARRANTED.

ORGANIZATION OF INSTRUCTIONAL UNITS

THE INSTRUCTIONAL UNITS ARE BASED UPON THE COMPETENCIES OF ENTRY LEVEL OCCUAPTIONS IN AGRICULTURAL EQUIPMENT AND MECHANICS. THESE COMPETENCIES WERE OBTAINED FROM PREVIOUS RESEARCH STUDIES CONDUCTED BY VARIOUS PERSONS AT VARIOUS INSTITUTIONS AND ORGANIZATIONS THROUGHOUT THE UNITED STATES. ATTENTION WAS ALSO GIVEN

TO CURRICULA DEVELOPED BY OTHER INSTITUTIONS AND ORGANIZATIONS FOR OCCUPATIONS IN AGRICULTURAL EQUIPMENT AND MECHANICS IN DETERMINING THE FINAL FORM AND CONTENT OF THE INSTRUCTIONAL UNITS.

SOME OF THE MAJOR SOURCES OF OCCUPATIONAL COMPETENCIES THAT WERE CONSULTED OR REFERRED TO IN DEVELOPING THIS CURRICULUM GUIDE ARE LISTED BELOW. THIS, IN NO WAY, IS INTENDED TO IMPLY THAT THESE ARE THE ONLY AND/OR BEST SOURCES OF COMPETENCIES AVAILABLE. IT IS MERELY A LIST OF THE SOURCES OF COMPETENCIES USED IN DEVELOPING THIS CURRICULUM GUIDE. THE MAJOR COMPETENCY SOURCES UTILIZED WERE:

BISHOP, DOUGLAS E. A STUDY TO DETERMINE COMPETENCIES NEEDED FOR EMPLOYEES ENTERING AGRICULTURAL MECHANICS OCCUPATIONS. BOZEMAN, MONTANA: DEPARTMENT OF AGRICULTURAL AND INDUSTRIAL EDUCATION, THE MONTANA STATE UNIVERSITY. 1973.

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GENTRY, GENE A. MECHANICAL COMPETENCIES NEEDED FOR EMPLOYMENT IN FARM MACHINERY SALES AND SERVICE AND FARM SUPPLIES AND EQUIPMENT BUSINESSES. COLLEGE PARK, MARYLAND: DEPARTMENT OF AGRICULTURAL AND EXTENSION EDUCATION, UNIVERSITY OF MARYLAND. 1966.

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FORMAT OF THE UNITS OF INSTRUCTION

EACH OF THE UNITS OF INSTRUCTION HAVE SEVEN ELEMENTS TO BE USED FOR DEVELOPING SPECIFIC CURRICULUM AND CURRICULUM MATERIALS. THE LIST OF ELEMENTS INCLUDES:

1. UNIT CONCEPT
2. STUDENT PERFORMANCE OBJECTIVES
3. INSTRUCTIONAL AREAS
4. EXAMPLES OF STUDENT LEARNING ACTIVITIES
5. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE
6. INSTRUCTIONAL MATERIALS OR EQUIPMENT
7. EXAMPLES OF SUPPORTING REFERENCES

A DESCRIPTION OF THE SEVEN ELEMENTS OF THE UNITS OF INSTRUCTION

UNIT CONCEPT

THE UNIT CONCEPT DEFINES THE RATIONALE FOR THE AREA COVERED BY THE INSTRUCTIONAL UNIT.

STUDENT PERFORMANCE OBJECTIVES

THE STUDENT PERFORMANCE OBJECTIVES HAVE BEEN CONSIDERED THE BASIC ELEMENT OF THE UNITS OF INSTRUCTION. ALL OTHER ELEMENTS

ARE DEVELOPED FROM THE PERFORMANCE OBJECTIVES. THE OBJECTIVES ARE STATED IN STUDENT TERMS AT A TERMINAL PERFORMANCE LEVEL. THE TERMINAL PERFORMANCES HAVE BEEN DEFINED FROM AN ANALYSIS OF COMPETENCIES NECESSARY FOR SUCCESSFUL PERFORMANCE IN THE ENTRY LEVEL SKILLED OCCUPATIONS OF AGRICULTURAL EQUIPMENT AND MECHANICS.

THE PERFORMANCE OBJECTIVES OF THE GUIDE ARE INTENDED TO AID CURRICULUM SPECIALISTS AND TEACHERS OF LOCAL AGRICULTURAL EQUIPMENT AND MECHANICS PROGRAMS IN DEFINING THE COMPETENCIES WHICH CAN AND SHOULD BE ACQUIRED BY STUDENTS IN LOCAL PROGRAMS.

IT WAS FELT THAT COMPETENT TEACHERS OF A VOCATIONAL PROGRAM WOULD BE IN THE BEST POSITION TO ESTABLISH "HOW WELL" THE OBJECTIVE SHOULD BE PERFORMED, AND THE CONDITIONS UNDER WHICH IT SHOULD BE PERFORMED. HOWEVER, CONDITIONS AND STANDARDS HAVE BEEN INDICATED FOR MOST OBJECTIVES. THE INTENT IS TO DIRECT ATTENTION TO THOSE CONDITIONS WHICH MAY SIGNIFICANTLY AFFECT ACHIEVING THE PERFORMANCE AND IDENTIFY STANDARDS WHICH MAY BE ESPECIALLY IMPORTANT TO SUCCESS IN THE INDUSTRY.

INSTRUCTIONAL AREAS

THE PERFORMANCE OBJECTIVES ARE DESCRIPTIONS OF INTENDED OUTCOMES WHICH REQUIRE THE ACQUISITION OF CERTAIN KNOWLEDGE AND SKILLS. TITLES AND SUBTITLES OF INSTRUCTIONAL AREAS ARE USED TO DEFINE THE RELEVANT CONTENT.

THE TITLES ARE PRESENTED IN AN ACTION FORM AS FAR AS IS FEASIBLE TO HELP DEFINE THE SPECIFIC TYPE OF LEARNING EXPECTED TO ACHIEVE THE OBJECTIVES. RATHER THAN LIMITING THE TITLE BY USING "AGRICULTURAL EQUIPMENT BODY RECONDITIONING" IN DEFINING STUDY AREAS CONCERNING AGRICULTURAL EQUIPMENT BODY RECONDITIONING, THE SUBSTUDY AREAS OF CLEANING AGRICULTURAL EQUIPMENT, PREPARING CLEANED AGRICULTURAL EQUIPMENT FOR APPLYING PRIMER, OPERATING SPRAY PAINTING EQUIPMENT, APPLYING THE PRIMER COAT, AND APPLYING THE FINISH COAT ARE USED. THE GERUND VERB FORM OR "-ING" FORM OF THE TITLE IS TO AID IN MORE SPECIFICALLY DEFINING THE COMPETENCIES TO BE BROUGHT OUT IN THE LEARNING PROCESSES.

BECAUSE OF THE SPECIFIC NATURE OF MUCH OF THE LEARNING MATERIALS NEEDED FOR THESE INSTRUCTIONAL AREAS, REFERENCES ARE CITED WHICH WOULD BE APPROPRIATE FOR CURRICULUM DEVELOPERS. THE TITLES FOR THE INSTRUCTIONAL AREAS ARE OF A RELATIVELY PERMANENT NATURE AND COMMON TO MOST PROGRAMS. THE SPECIFIC CONTENT TO SUPPORT THEM IS MUCH MORE ADVERSELY AFFECTED BY CHANGES IN TECHNOLOGY, GEOGRAPHICAL DIFFERENCES OR DIFFERENCES IN LOCAL OCCUPATIONAL CHARACTERISTICS.

IT MAY BE POSSIBLE TO USE THE SUGGESTED TITLES OVER A PERIOD OF TIME WITH RELATIVELY MINOR ADJUSTMENTS. SPECIFIC CONTENT, ON THE OTHER HAND, NEEDS TO BE CONTINUALLY UPDATED TO CURRENT CONDITIONS AND MATCHED WITH LOCAL STUDENT NEEDS AND OCCUPATIONAL CHARACTERISTICS.

THE NUMBERING OF THE INSTRUCTIONAL AREA TITLES IS NOT MATCHED TO THE NUMBERS OF THE STUDENT PERFORMANCE OBJECTIVES. HOWEVER, INSTRUCTIONAL AREAS RELATING TO AN OBJECTIVE CAN BE DETERMINED RELATIVELY EASILY. THE INSTRUCTIONAL AREAS ARE SEQUENCED AS MUCH AS IS FEASIBLE IN THE SAME ORDER AS THE PERFORMANCE OBJECTIVES TO WHICH THEY RELATE.

EXAMPLES OF STUDENT LEARNING ACTIVITIES

EXAMPLES ARE PROVIDED SUGGESTING WAYS IN WHICH STUDENTS MAY BE ACTIVELY INVOLVED IN LEARNING ACTIVITIES THAT WOULD HELP THEM ACHIEVE THE OBJECTIVES. THEY ARE OFFERED AS ONE APPROACH THAT MAY BE USED RATHER THAN INTENDED TO BE THE COMPLETE LIST OF ACTIVITIES WHICH WOULD PROVIDE THE MOST EFFECTIVE LEARNING. THE SUGGESTED ACTIVITIES FOR EACH OBJECTIVE MAY OR MAY NOT COVER THE ENTIRE OBJECTIVE. THEREFORE, DEVELOPMENT OF OTHER ACTIVITIES FOR THE LOCAL PROGRAM WILL BE NECESSARY FOR A COMPREHENSIVE PROGRAM.

THERE IS AT LEAST ONE ACTIVITY FOR EACH STUDENT PERFORMANCE OBJECTIVE. THE NUMBER ON THE ACTIVITY IS THE SAME AS THE STUDENT PERFORMANCE OBJECTIVE TO WHICH IT IS RELATED.

EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

THE STUDENT EVALUATION SHOULD BE DIRECTED TOWARD AND BASED UPON WELL-WRITTEN STUDENT PERFORMANCE OBJECTIVES. IN THIS GUIDE, THE STUDENT PERFORMANCE OBJECTIVES ARE INTENDED TO BE EXPLICITLY STATED IN WHAT TERMINAL PERFORMANCE THE STUDENT IS TO BE ABLE TO DO AND, TO SOME DEGREE, HOW WELL AND UNDER WHAT CONDITIONS. PRIMARILY, THE EVALUATION IS TO USE THE STATED OBJECTIVES AS A REFERENCE POINT TO ANSWER THE QUESTION - CAN THE STUDENT ACHIEVE THE DESIRED PERFORMANCE LEVEL?

IN ADDITION, AN ELEMENT DESIGNATED AS "EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE" IS INCLUDED IN EACH UNIT OF INSTRUCTION. EXAMPLES OF EVALUATION PROCESSES ARE INTENDED TO ASSIST IN DETERMINING THE LEVEL OF UNDERSTANDING OF THE ABILITY OF THE STUDENT TO ACCOMPLISH PARTS OF OR THE ENTIRE PERFORMANCE OBJECTIVE. THESE PROCESSES ARE NOT INTENDED TO REPLACE A DIRECT EVALUATION OF THE TERMINAL PERFORMANCE AS STATED IN THE OBJECTIVE.

THE TYPE OF EVALUATION PROCESS IS DETERMINED IN PART BY THE NATURE OF THE PERFORMANCE OBJECTIVES. BUT THE MOST DESIRABLE

METHOD CAN BE BEST DETERMINED WHEN THERE IS KNOWLEDGE OF THE LOCAL SITUATION, SUCH AS EDUCATIONAL RESOURCES, SCHOOL POLICIES AND THE NEEDS OF THE STUDENTS.

THERE IS AT LEAST ONE EVALUATION PROCESS FOR EACH STUDENT PERFORMANCE OBJECTIVE. THE NUMBER ON THE EVALUATION ACTIVITY IS THE SAME AS THE STUDENT PERFORMANCE OBJECTIVE TO WHICH IT IS RELATED.

INSTRUCTIONAL MATERIALS OR EQUIPMENT

MATERIALS OR EQUIPMENT ARE NOTED WHICH ARE SPECIFIC TO THE UNIT AND WHICH ARE CONSIDERED ESSENTIAL OR QUITE DESIRABLE IN THE LEARNING PROCESS. IN SOME CASES, THE OBJECTIVES WOULD BE QUITE DIFFICULT TO ACHIEVE, IF AT ALL, WITHOUT THE MATERIALS. IN OTHERS, THE MATERIALS OR EQUIPMENT AID IN THE EFFECTIVENESS OR EFFICIENCY OF LEARNING.

THE MATERIALS AND EQUIPMENT SUGGESTED FOR ONE UNIT ARE NOT NECESSARILY CONSUMED OR UNIQUE JUST TO THE LEARNING ACTIVITIES OF THAT UNIT. A LIST OF THE EQUIPMENT SUGGESTED FOR A COMPREHENSIVE AGRICULTURAL EQUIPMENT AND MECHANICS PROGRAM IS LISTED IN APPENDIX A.

EXAMPLES OF SUPPORTING REFERENCES

A LIMITED NUMBER OF REFERENCES HAVE BEEN LISTED WHICH DIRECTLY RELATE TO THE CURRICULUM STUDY AREAS SUGGESTED IN THE "INSTRUCTIONAL AREAS" SECTION. THESE REFERENCES ARE AVAILABLE AND THE SOURCES OR DETAILS OF SECURING THEM ARE LOCATED IN APPENDIX B OF THIS GUIDE.

WHEN TWO OR MORE REFERENCES ARE FOUND TO HAVE ADEQUATE LEARNING MATERIALS AND PROCESSES FOR THE OBJECTIVES OF A UNIT BUT HAVE UNIQUELY DIFFERENT STYLES, THE GROUP MAY BE LISTED SO THAT THE TEACHER HAS THE CHOICE OF SELECTING THE ONE MOST SUITED TO HIS TEACHING.

IN SOME CASES, SEVERAL REFERENCES ARE NOTED BECAUSE NO ONE REFERENCE ADEQUATELY COVERS ALL OF THE OBJECTIVES OF A UNIT OR STUDY AREA. ANNOTATIONS OF THE REFERENCES ARE PROVIDED TO AID IN DETERMINING WHICH REFERENCE OR REFERENCES WOULD BE BEST SUITED FOR A LOCAL PROGRAM. THE REFERENCE SUGGESTED FOR ONE UNIT IS OFTEN RELEVANT TO AND SUGGESTED FOR USE IN SEVERAL OF THE UNITS. IN NO WAY SHOULD THE REFERENCES BE CONSIDERED THE BEST OR ONLY REFERENCES TO BE USED WITH THE UNITS.

RECOMMENDED FACILITIES AND EQUIPMENT

SUGGESTIONS FOR PLANNING THE FACILITIES FOR AGRICULTURAL EQUIPMENT AND MECHANICS

THE NATURE AND THE EXTENT OF THE FACILITIES NEEDED FOR AGRICULTURAL EQUIPMENT AND MECHANICS INSTRUCTION WILL BE INFLUENCED BY THE PROJECTED ENROLLMENTS, THE PLANNED USE OF THE FACILITIES BY CONTINUING EDUCATION AND OTHER GROUPS, AND THE AREAS OF EMPHASIS TO BE INCLUDED IN THE COURSE OF STUDY. THE SUGGESTIONS WHICH FOLLOW ARE TO BE CONSIDERED ONLY AS GUIDES FOR SCHOOL FACILITY PLANNERS AND ARCHITECTS.

SPACE ALLOCATIONS

RECOMMENDED MINIMUM SPACE ALLOCATIONS FOR ACCOMODATING TWENTY STUDENTS PER SECTION INCLUDE:

CLASSROOM --- 750 SQUARE FEET
OFFICE/CONFERENCE ROOM --- 200 SQUARE FEET
SHOP OR LABORATORY --- 7,000 SQUARE FEET
OUTSIDE PAVED AND FENCED STORAGE AREA --- 3,500 SQUARE FEET OF WHICH 1,500 SQUARE FEET IS COVERED BY ROOF

CLASSROOM

THE CLASSROOM SHOULD BE EQUIPPED WITH MOVABLE TABLES AND CHAIRS TO ACCOMODATE A MINIMUM OF TWENTY STUDENTS, A TACK BOARD, SUFFICIENT CHALK BOARD SPACE, A TEACHER'S DESK OR MOVABLE TEACHER'S WORK BENCH, FILING CABINETS, SHELF SPACE, A PROJECTION SCREEN AND ADEQUATE ELECTRICAL OUTLETS.

A SMALL DISPLAY AND SALES COUNTER WITH A CASH REGISTER AND CALCULATOR CAN BE SET UP FOR STUDENTS TO USE. SUCH EQUIPMENT MAY BE OBTAINED FROM THE AGRICULTURAL BUSINESS SUPPLIES AND SERVICE PROGRAM WHEN SUCH A PROGRAM IS OFFERED IN THE SAME SCHOOL.

CONSIDERATION SHOULD BE GIVEN TO PROVIDE AN ENTRANCE FROM THE SHOP TO THE CLASSROOM OF AT LEAST 7 FEET WIDE TO PERMIT BRINGING SHOP ITEMS INTO THE CLASSROOM WHEN DESIRED.

OFFICE/CONFERENCE ROOM

THE OFFICE AND CONFERENCE ROOM SHOULD BE EQUIPPED WITH A TEACHER'S DESK FOR EACH TEACHER IN THE AGRICULTURAL EQUIPMENT

AND MECHANICS PROGRAM, SEVERAL MOVABLE TABLES AND CHAIRS, FILING CABINETS, STORAGE SHELVES FOR AUDIOVISUAL EQUIPMENT, SUFFICIENT ELECTRICAL OUTLETS AND A TELEPHONE. WINDOWS SHOULD BE PROVIDED TO GIVE A VIEW OF BOTH THE SHOP AND CLASSROOM FROM THE OFFICE. THE OFFICE AND CONFERENCE ROOM SHOULD BE LOCATED BETWEEN THE SHOP AND CLASSROOM TO AID IN BUFFERING NOISE FROM THE SHOP.

MECHANICS SHOP

SUITABLE FACILITIES IN THE MECHANICS SHOP SHOULD BE PROVIDED FOR STUDENTS TO WORK ON BOTH THE REPAIR AND SERVICING OF POWER UNITS AND THE ASSEMBLY OF AGRICULTURAL EQUIPMENT. IT MAY BE DESIRABLE TO CONSIDER THE FOLLOWING FACTORS WHEN DESIGNING AND CONSTRUCTING THE MECHANICS SHOP AREA.

SPACE

THE SHOP AREA SHOULD BE OF A CLEAR SPAN CONSTRUCTION WITH A MINIMUM OVERHEAD CLEARANCE OF 16 FEET. PROVISIONS SHOULD BE MADE IN THE SHOP FOR A MOVABLE OVERHEAD HOIST. CONSTRUCTION OF THE SHOP FACILITY SHOULD EMPHASIZE A 20-FOOT AISLE DOWN THE LENGTH OF THE MECHANICS SHOP IN LINE WITH THE LARGE OVERHEAD DOOR EXIT. THE ADJACENT AREAS SHOULD HAVE A MINIMUM CLEARANCE OF 14 FEET.

SUFFICIENT SPACE SHOULD BE PROVIDED FOR A MINIMUM OF 15 WORK BAYS OF APPROXIMATELY 10 FEET BY 20 FEET TO BE LAID OUT. FOR THE SET-UP, CLEANING AND SERVICING OF LARGER EQUIPMENT, ONE OR TWO AREAS OF 20 FEET BY 20 FEET SHOULD BE ALLOCATED.

FLOORS

FLOORS SHOULD BE OF CONCRETE, SLOPED AT ALL PLACES TO A DRAIN. DRAINAGE MAY BE A SERIES OF FLOOR DRAINS ALONG THE CENTER LINE OF THE SHOP OR TO GRATING-COVERED GUTTERS OR TROUGHS RUNNING THE LENGTH OF THE SHOP ADJACENT TO THE WORK BAYS. CONCRETE FLOORS SHOULD BE SEALED.

DOORS

OVERHEAD DOORS SHOULD BE HIGH AND WIDE ENOUGH TO ACCOMODATE LARGE MACHINES. THE LARGE OVERHEAD SHOP DOOR SHOULD BE A MINIMUM OF 16 FEET BY 16 FEET AND CONSTRUCTED OF STEEL AND TRANSLUCENT FIBER GLASS. DEPENDING UPON THE LAYOUT OF THE SHOP AREA IN RELATION TO THE TOTAL SCHOOL FACILITY, IT MAY BE DESIRABLE

TO HAVE SEVERAL 12-FOOT WIDE OVERHEAD DOORS LOCATED ALONG THE SIDE OF THE BUILDING, IN ADDITION TO THE 16-FOOT BY 16-FOOT MAIN OVERHEAD DOOR.

A SMALL PERSONNEL DOOR SHOULD ALSO BE INSTALLED NEXT TO THE LARGE OVERHEAD DOOR.

THE PAINT ROOM

THE ENCLOSED PAINT ROOM OF 20 FEET BY 20 FEET SHOULD BE LOCATED SUCH THAT AN OVERHEAD DOOR IS ADJACENT TO THE PAINT ROOM OR, MORE DESIRABLY, SO THAT AN OVERHEAD DOOR LEADS INTO THE PAINT ROOM. THE EXHAUST SYSTEM IN THE PAINT ROOM SHOULD COMPLETELY CHANGE THE AIR EVERY ONE MINUTE.

THE WELDING AREA

THE WELDING AREA SHOULD BE LOCATED NEXT TO AN OVERHEAD DOOR AND BE APPROXIMATELY 20 FEET BY 20 FEET IN SIZE. THE EXHAUST SYSTEM IN THE WELDING AREA SHOULD COMPLETELY CHANGE THE AIR EVERY ONE MINUTE.

THE TOOL AND STORAGE ROOM

THE TOOL ROOM SHOULD BE APPROXIMATELY 250 SQUARE FEET IN SIZE. THE STORAGE ROOM SHOULD CONTAIN A MINIMUM OF 150 SQUARE FEET. THE STORAGE ROOM COULD BE SO DESIGNED AS TO SIMULATE A DEALER'S PARTS DEPARTMENT. THE TOOL AND STORAGE ROOMS SHOULD BE LOCATED BETWEEN THE CLASSROOM AND SHOP AREAS TO AID IN BUFFERING NOISE FROM THE SHOP.

LOCKER AND RESTROOM FACILITIES

IN AN AREA ADJACENT TO THE SHOP, SOME PROVISIONS ARE NECESSARY FOR STUDENT LOCKERS AND LAVATORY FACILITIES.

AN INDUSTRIAL-TYPE WASHBASIN AND DRINKING FOUNTAIN ARE RECOMMENDED WITHIN THE SHOP AND NEAR THE ENTRANCE TO THE LOCKER-REST ROOM FACILITIES.

LIGHTING

PERMANENT OVERHEAD LIGHTING, CONTROLLED BY ZONES, SHOULD PROVIDE ADEQUATE AND UNIFORM ILLUMINATION THROUGHOUT THE SHOP WITHOUT SHADOWS OR GLARE.

PORTABLE LIGHTING IN THE FORM OF REEL-TYPE TROUBLE LAMPS OR STANDS WITH LIGHTS ARE DESIRABLE TO ILLUMINATE AREAS OF EQUIPMENT BEING SERVICED AND NOT REACHED BY THE GENERAL LIGHTING.

A MINIMUM NUMBER OF WINDOWS IN THE SHOP AREA WILL LEAVE WALL SPACE FOR TOOL CABINETS AND PANELS.

ELECTRICAL SERVICE

VARIOUS HEAVY APPLIANCES, SUCH AS AIR COMPRESSORS AND ARC WELDERS, REQUIRE HEAVY WIRING. EQUIPMENT TO BE INSTALLED, PLUS A RESERVE FOR FUTURE ADDITIONAL EQUIPMENT, SHOULD DETERMINE THE SERVICE FOR THE SPECIFIC FACILITY. IT IS, OF COURSE, MORE ECONOMICAL AND EFFICIENT TO USE 215- TO 230-VOLT, 3-PHASE CURRENT WHERE HEAVIER LOADS ARE INVOLVED. THIS REQUIRES COORDINATION BETWEEN WRITING EQUIPMENT SPECIFICATIONS, BUILDING PLANNING AND THE POWER COMPANY.

OUTLETS PROVIDING 230-VOLT, 60-AMPERE SERVICE SHOULD BE LOCATED AT SUCH POINTS ABOUT THE SHOP AND OUTDOOR AREA THAT PORTABLE ARC WELDERS CAN BE USED UNIVERSALLY. RECEPTACLES PROVIDING 115-VOLT SERVICE SHOULD BE LOCATED ALONG ALL WALLS. IT IS RECOMMENDED THAT DROP CORDS FROM THE CEILING BE CONVENIENT TO EACH WORK STATION.

WATER

CONSIDERATION SHOULD BE GIVEN TO MAKING AVAILABLE A MIXING HOT AND COLD WATER FIXTURE BETWEEN EVERY TWO BAYS.

COMPRESSED AIR

IT IS SUGGESTED THAT OUTLETS FOR PRESSURE-REGULATED AIR BE AVAILABLE AT EACH WORK STATION SO THAT PNEUMATIC EQUIPMENT CAN BE USED ANYWHERE IN THE SHOP.

HEATING

IT IS SUGGESTED THAT THE HEATING SYSTEM BE OVERHEAD, ADEQUATE FOR THE AREA, AUTOMATICALLY CONTROLLED, AND OPERATE WITHOUT DISTURBING NOISE OR FUMES. CONSIDERATION SHOULD BE GIVEN TO GAS OR ELECTRIC RADIANT HEAT.

VENTILATION

ENGINE EXHAUST IS LETHAL AND IRRITATING. THE EXHAUST FANS

SHOULD BE ADEQUATE TO CHANGE THE AIR IN THE GENERAL SHOP AREA EVERY TWO MINUTES. DROP PICK-UPS FOR ENGINE EXHAUSTS SHOULD BE CONSIDERED WHEN DESIGNING THE VENTILATION SYSTEM.

OUTSIDE PAVED AND FENCED STORAGE AREA

IT IS IMPORTANT THAT AN AREA OF CONSIDERABLE SIZE, PREFERABLY PAVED, BE PROVIDED IMMEDIATELY ADJACENT TO THE SHOP. IN GOOD WEATHER, SOME SERVICE INSTRUCTION CAN BE GIVEN IN THIS AREA, EQUIPMENT CAN BE CLEANED, AND INACTIVE EQUIPMENT CAN BE PARKED. IT MAY BE SHARED WITH OTHER AGRICULTURE COURSES. IN SUCH INSTANCES, THE SIZE SHOULD BE ADJUSTED ACCORDINGLY.

A SUGGESTED LAYOUT IS TO BUILD A TOOL SHED, OPEN ALONG ONE SIDE OF THE PAVED AREA WITH ITS CLOSED BACK TO THE PREVAILING WINDS. COMPLETION OF THE REMAINING SIDES OF THE AREA IS DONE WITH NON-CLIMBABLE FENCE TOGETHER WITH A 16-FOOT GATE AND FLOOD LIGHTS. THE SHED SERVES AS A SUITABLE STORAGE FOR A TRUCK, OTHER LARGE EQUIPMENT, AND FOR DEAD STORAGE OF MACHINES AWAITING REPAIR.

INCLUDED IN THIS AREA SHOULD BE PROVISIONS FOR HOT AND COLD WATER WITH A MIXING VALVE, AMPLE OUTLETS FOR WELDING, PORTABLE TOOLS AND LIGHTS AND AIR OUTLETS FOR SPRAY PAINTING AND OTHER USES.

CONSIDERATION SHOULD BE GIVEN TO INSTALLING AN ELEVATED WASH RACK AND A DRAIN WITH A SLUDGE PIT FOR USE IN CLEANING MACHINERY.

PROVISIONS SHOULD BE MADE NEAR THE ENCLOSED AREA FOR AN OUTDOOR RAMP TO LOAD AND UNLOAD EQUIPMENT.

SUGGESTIONS FOR DEVELOPING LISTS OF NEEDED EQUIPMENT AND SUPPLIES

THE TYPE AND QUANTITIES OF EQUIPMENT AND SUPPLIES REQUIRED TO PROVIDE EFFECTIVE OCCUPATIONAL EDUCATION IN AGRICULTURAL EQUIPMENT AND MECHANICS WILL DEPEND UPON SEVERAL FACTORS. THESE INCLUDE: THE ANTICIPATED SIZES OF THE GROUPS TO BE SERVED; THE TYPES OF GROUPS TO BE SERVED, THAT IS, SECONDARY OR ADULT; THE EMPHASIS TO BE INCLUDED IN THE COURSE OF STUDY IN TERMS OF THE DIVERSIFICATION OR SPECIALIZATION; AND OTHER FACTORS.

THE OPTIMUM CLASS SIZE IS CONSIDERED, FOR PLANNING PURPOSES, TO BE TWENTY PUPILS. SUFFICIENT QUANTITIES OF TOOLS, EQUIPMENT AND SUPPLIES SHOULD BE PROVIDED TO MAKE MAXIMUM USE OF THE TIME AVAILABLE FOR LABORATORY AND PRACTICAL EXERCISES. THIS WILL NOT REQUIRE NECESSARILY THAT TWENTY DUPLICATES OF A SPECIFIC

ITEM WILL BE NEEDED AS PROPER MANAGEMENT OF PRACTICAL SITUATIONS WILL SELDOM RESULT IN EACH PUPIL USING THE IDENTICAL ITEM AT THE SAME TIME.

PROVISIONS SHOULD BE MADE, WHEN IT IS POSSIBLE TO DO SO, TO PURCHASE SEVERAL DIFFERENT BRANDS OF THE SAME ITEM. THIS WILL PROVIDE OPPORTUNITIES FOR PUPILS TO BECOME FAMILIAR WITH THE PRODUCTS OF COMPETING MANUFACTURERS, RATHER THAN JUST ONE.

AN ADVISORY COMMITTEE COMPOSED OF REPRESENTATIVES OF LOCAL AGRICULTURAL EQUIPMENT AND MECHANICS INDUSTRY PERSONNEL CAN PROVIDE INVALUABLE ASSISTANCE IN DEVELOPING LISTS OF NEEDED EQUIPMENT AND SUPPLIES.

BECAUSE INSTRUCTION IN AGRICULTURAL EQUIPMENT AND MECHANICS SKILLS IS RECOMMENDED AS A PART OF THE TOTAL PROGRAM, IT WILL BE NECESSARY TO PROVIDE TOOLS AND EQUIPMENT TO OUTFIT THE AGRICULTURAL EQUIPMENT AND MECHANICS LABORATORY. THE TYPES AND NUMBERS OF SUCH ITEMS TO BE PURCHASED WILL BE DEPENDENT ON THEIR AVAILABILITY IN OTHER OCCUPATIONAL PROGRAMS AT THE SCHOOL OR AREA OCCUPATIONAL EDUCATION CENTER.

TEACHER REQUIREMENTS AND RESPONSIBILITIES

IN ORDER FOR AN AGRICULTURAL EQUIPMENT AND MECHANICS CURRICULUM TO BE EFFECTIVE, THE TEACHING STAFF MUST BE COMPETENT AND ENTHUSIASTIC. THE SPECIALIZED NATURE OF THE CURRICULUM REQUIRES THAT THE TEACHER(S) HAVE COMPETENCIES IN REPAIRING, SERVICING, ADJUSTING AND SELLING AGRICULTURAL EQUIPMENT, GAINED THROUGH EXPERIENCE AND SPECIALIZED TRAINING IN AGRICULTURAL EQUIPMENT AND MECHANICS.

THE TEACHER(S) SHOULD UNDERSTAND THE EDUCATIONAL PHILOSOPHY, THE OBJECTIVES AND THE SPECIFIC REQUIREMENTS OF THE PROGRAM. THEY WILL NEED TO BE ABLE TO ORGANIZE AND DEVELOP PROGRAMS FOR EACH INDIVIDUAL SO THAT HE MEETS THE REQUIREMENTS OF THE OCCUPATIONAL CLUSTER(S) THAT HE IS PREPARING TO ENTER.

RESPONSIBILITIES OF THE TEACHER(S) INCLUDE:

1. PLANNING A PROGRAM OF AGRICULTURAL EQUIPMENT AND MECHANICS INCLUDING WORKING WITH ADVISORY COMMITTEES AND DEVELOPING A CURRICULUM TO FIT LOCAL NEEDS
2. TEACHING CLASSES
3. SUPERVISING OCCUPATIONAL EXPERIENCE PROGRAMS
4. SELECTING AND UTILIZING FACILITIES AND EQUIPMENT

5. ADVISING YOUTH ORGANIZATIONS
6. INFORMING THE PUBLIC REGARDING THE PROGRAM, ITS ACTIVITIES AND STUDENTS' PROGRESS
7. UTILIZING COMMUNITY RESOURCES
8. PROVIDING SAFETY INSTRUCTION AND PRACTICES
9. GUIDING AND COUNSELING STUDENTS
10. PLACEMENT AND FOLLOW-UP OF STUDENTS

MOTIVATION AND MORALE BUILDING SHOULD BE A PART OF EVERY CLASS AND LABORATORY PERIOD. IT IS SUGGESTED THAT THE INSTRUCTOR MAKE AN EFFORT EARLY IN THE PROGRAM TO ESTABLISH AN ENVIRONMENT WHICH WILL HEIGHTEN AND MAINTAIN THE STUDENTS' INTEREST. THE SUCCESS OF THE PROGRAM CAN BE JUDGED PRIMARILY BY THE NUMBER OF STUDENTS WHO REMAIN GAINFULLY EMPLOYED IN CAREERS WHICH WOULD OTHERWISE NOT HAVE BEEN AVAILABLE TO THEM.

Scientific and Technical Societies and Trade Associations

SCIENTIFIC AND TECHNICAL SOCIETIES AND COMMERCIAL FIRMS AND TRADE GROUPS ARE AN IMPORTANT SOURCE OF INSTRUCTIONAL MATERIALS AND OTHER BENEFITS FOR TEACHERS AND STUDENTS. THESE SOCIETIES, IN THEIR PUBLICATIONS AND AT MEETINGS, PROVIDE CONTINUAL EXPOSURE TO THE MOST RECENT DEVELOPMENTS IN THE SCIENCE AND RELATED TECHNOLOGIES AND PROBABLY SERVE AS THE BEST MEANS FOR HELPING PERSONS KEEP UP-TO-DATE IN A PARTICULAR PHASE OF SCIENCE.

LESS CONSPICUOUS, BUT EXTREMELY IMPORTANT, IS THE SUPPORT WHICH SOCIETIES MAY GIVE: (1) IN HELPING TO DEVELOP EVIDENCE OF THE NEED FOR THE TRAINING PROGRAM; (2) IN HELPING TO PROMOTE THE PROGRAM; (3) IN ENLISTING MEMBERS' SUPPORT FOR THE PROGRAM; (4) IN HELPING TO PROVIDE WORK EXPERIENCE FOR STUDENTS; AND (5) IN HELPING WITH THE PLACEMENT OF GRADUATES.

ASSOCIATIONS AND SOCIETIES MAY SUPPLY RESOURCE PEOPLE TO SPEAK TO CLASSES. THEY MAY ALSO SERVE AS HOSTS TO STUDENT GROUPS ON FIELD TRIPS TO STUDY SPECIFIC PHASES OF THE INDUSTRY.

THE FOLLOWING IS A SELECTED LISTING OF SOME OF THE ORGANIZATIONS AND ASSOCIATIONS WHICH ARE PERTINENT TO AGRICULTURAL EQUIPMENT AND MECHANICS:*

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* SEE APPENDIX C FOR A COMPLETE ADDRESS OF THESE ORGANIZATIONS AND ASSOCIATIONS

ALLIS CHALMERS MANUFACTURING COMPANY
AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS
AMERICAN PETROLEUM INSTITUTE
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
AMERICAN TECHNICAL EDUCATION ASSOCIATION, INC.
AMERICAN WELDING SOCIETY
AUTOLITE-FORD PARTS DIVISION
AUTOMOTIVE ELECTRICAL ASSOCIATION
AVCO NEW IDEA FARM EQUIPMENT DIVISION
THE BLACK AND DECKER MANUFACTURING COMPANY
BRIGGS AND STRATTON CORPORATION
BROWN AND SHARPE MANUFACTURING COMPANY
DAVID BROWN TRACTORS
J. I. CASE COMPANY
CATERPILLAR TRACTOR COMPANY
CHAMPION SPARK PLUG COMPANY
CUMMINS ENGINE COMPANY
DANA CORPORATION
JOHN DEERE SERVICE PUBLICATIONS
DELCO-REMY
DEVILBISS COMPANY
DIESEL ENGINE MANUFACTURERS' ASSOCIATION
ESB BRANDS, INC.
ETHYL CORPORATION
FARM AND INDUSTRIAL EQUIPMENT INSTITUTE
FARM EQUIPMENT MANUFACTURERS' ASSOCIATION
FORD TRACTOR OPERATIONS
IGNITION MANUFACTURERS' INSTITUTE
INTERNATIONAL HARVESTER COMPANY
JACOBSEN MANUFACTURING COMPANY
KOHLER COMPANY
LAWN-BOY
LINCOLN ARC WELDING FOUNDATION
MASSEY-FERGUSON, LTD.
MILLERS FALLS COMPANY
NATIONAL FARM AND POWER EQUIPMENT DEALERS ASSOCIATION
NATIONAL FLUID POWER ASSOCIATION
NATIONAL SAFETY COUNCIL
NICHOLSON FILE COMPANY
C. E. NIEHOFF AND COMPANY
ONAN
OLIVER
OUTDOOR CORPORATION
ROCKWELL
SEARS, ROEBUCK AND COMPANY
SIOUX TOOLS, INC.
SMITH WELDING EQUIPMENT
STANLEY TOOLS
THE L. S. STARRET COMPANY
TECUMSEH PRODUCTS COMPANY
TELEDYNE WISCONSIN MOTOR

TIMKEN ROLLER BEARING COMPANY
UNION CARBIDE CORPORATION
VICKERS DIVISION OF SPERRY RAND CORPORATION
VISUAL EDUCATION, INC.
WHITE FARM EQUIPMENT

EMPLOYMENT OPPORTUNITIES IN AGRICULTURAL EQUIPMENT AND MECHANICS

A GENERALLY ACCEPTED DEFINITION OF THE SCOPE OF THE AGRICULTURAL EQUIPMENT AND MECHANICS CURRICULUM AREA, AS OUTLINED IN VOCATIONAL EDUCATION AND OCCUPATIONS (U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE, 1969), IS AS FOLLOWS:

> "A COMBINATION OF SUBJECT MATTER AND EXPERIENCES DESIGNED TO DEVELOP IN PUPILS THE ABILITIES TO (1) RECOGNIZE AND IDENTIFY THE FUNDAMENTAL PRINCIPLES OF SELECTION, OPERATION, SERVICE MAINTENANCE, REPAIR AND SAFETY IN AGRICULTURAL POWER ---ENGINES, ELECTRICITY AND HYDRAULICS AND (2) PLAN, INSTALL, SERVICE, ASSEMBLE, ADJUST, AND OPERATE AND REPAIR FARM MACHINERY."

EMPLOYMENT OPPORTUNITIES IN THE AGRICULTURAL EQUIPMENT AND MECHANICS INDUSTRY WILL VARY FROM REGION TO REGION. IT IS RECOMMENDED THAT EACH STATE AND LOCAL AREA SURVEY THEIR PUBLICS TO ASSESS THE POTENTIAL FOR EMPLOYMENT OPPORTUNITIES IN THE AGRICULTURAL EQUIPMENT AND MECHANICS INDUSTRY. THE RESULTS OF SUCH A SURVEY SHOULD BE UTILIZED BEFORE DECISIONS ARE MADE TO IMPLEMENT AND OPERATE PROGRAMS IN LOCAL SCHOOLS TO PREPARE PERSONS FOR EMPLOYMENT IN AGRICULTURAL EQUIPMENT AND MECHANICS. SOME CONCERN HAS BEEN EXPRESSED IN CERTAIN AREAS THAT THE LABOR MARKET IN AGRICULTURAL EQUIPMENT AND MECHANICS MAY BE EASILY SATURATED. THEREFORE, IT IS HIGHLY RECOMMENDED THAT EACH STATE CONDUCT A SURVEY TO ACCURATELY DETERMINE THE EMPLOYMENT POTENTIAL IN THE AGRICULTURAL EQUIPMENT AND MECHANICS INDUSTRY.

THE TOTAL OCCUPATIONAL LADDER IN AGRICULTURAL EQUIPMENT AND MECHANICS, WHICH WAS DEVELOPED BY THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION IN AUGUST, 1965, IS OUTLINED IN CHART I.

FROM THE LIST OF OCCUPATIONS IN AGRICULTURAL EQUIPMENT AND MECHANICS, THE FOLLOWING SIX OCCUPATIONS WERE IDENTIFIED BY THE REPRESENTATIVES FROM INDUSTRY ON THE ADVISORY COMMITTEE TO THE PROJECT AS ENTRY LEVEL OCCUPATIONS WHICH CAN BE PREPARED FOR AT THE HIGH SCHOOL LEVEL.

AGRICULTURAL EQUIPMENT PARTS MAN	185.168

CHART I

OCCUPATIONAL TITLES IN AGRICULTURAL EQUIPMENT AND MECHANICS BY FIELD OF ACTIVITY

(WITH RELATED TITLES USED IN SOME BUSINESSES OR STATES)

Field of Activity	Occupational Titles	Related Titles and Other Designations	D.O.T. No.
Managerial	Agricultural Equipment Branch Manager		185.168
	Ag. Equipment Manager	Ag. Equipment Dealer	185.168
	Ag. Equipment Department Manager	Ag. Equipment Sales Manager Ag. Equipment Service Manager Ag. Equipment Parts Manager Ag. Equipment Office Manager	185.168
Professional and Technical	Ag. Equipment Engineer	Ag. Equipment Product Engineer Ag. Equipment Field Engineer	013.081
	Ag. Equipment Fieldman	Ag. Equipment Sales Representative Ag. Equipment Service Representative	180.118
Clerical	Ag. Equipment Bookkeeper	Ag. Equipment Office Clerk	219.388
	Ag. Equipment Secretary		209.588
Sales	Ag. Equipment Salesman	Ag. Equipment Sales Supervisor Ag. Equipment Product Salesman	277.358
	Ag. Equipment Sales Clerk		290.478
Service	Ag. Equipment Mechanic	Ag. Equipment Service Supervisor Tractor Mechanic Ag. Equipment Welder	624.281

CHART I (CONTINUED)

Field of Activity	Occupational Titles	Related Titles and Other Designations	D.O.T. No.
Service (con'd.)	Ag. Equipment Field Mechanic		624.381
	Ag. Equipment Parts Man	Ag. Equipment Parts Clerk	185.168
	Ag. Equipment Mechanic's Helper	Ag. Equipment Maintenance Worker	624.381
	Ag. Equipment Set-Up Man	Ag. Equipment Warehouseman	624.381
	Ag. Equipment Delivery-Man	Ag. Equipment Truck Driver	905.883

AGRICULTURAL EQUIPMENT MECHANICS HELPER	624.381
AGRICULTURAL EQUIPMENT MECHANIC	624.281
AGRICULTURAL EQUIPMENT SET-UP MAN AND DELIVERYMAN	624.381
AGRICULTURAL EQUIPMENT FIELD AND MAINTENANCE MAN	624.381
AGRICULTURAL EQUIPMENT DELIVERYMAN	905.883

THOMAS STITT, IN HIS STUDY "THE UNDERSTANDINGS AND ABILITIES NEEDED FOR SELECTED JOB TITLES OF FARM EQUIPMENT DEALERSHIPS IN OHIO," DEVELOPED A MODEL TO REPRESENT THE MOST COMMON MEANS OF EMPLOYEE ADVANCEMENT IN THE AGRICULTURAL EQUIPMENT AND MECHANICS INDUSTRY. (SEE FIGURE 1, PAGE 20.)

VALIDATION OF AGRICULTURAL EQUIPMENT AND MECHANICS UNITS

THE AGRICULTURAL EQUIPMENT AND MECHANICS UNITS HAVE BEEN DEVELOPED THROUGH THE USE OF MANY VARYING CURRICULUM GUIDES AND INSTRUCTIONAL MATERIALS ACCUMULATED FROM VARIOUS SOURCES THROUGHOUT THE UNITED STATES. THESE CURRICULUM GUIDES AND INSTRUCTIONAL MATERIALS RANGED FROM TOPIC OUTLINES TO COMPREHENSIVE REFERENCE MATERIALS. THE UNITS CONTAINED IN THIS GUIDE WILL HOPEFULLY PROVIDE A COMPREHENSIVE BASE FOR PROGRAM PLANNING

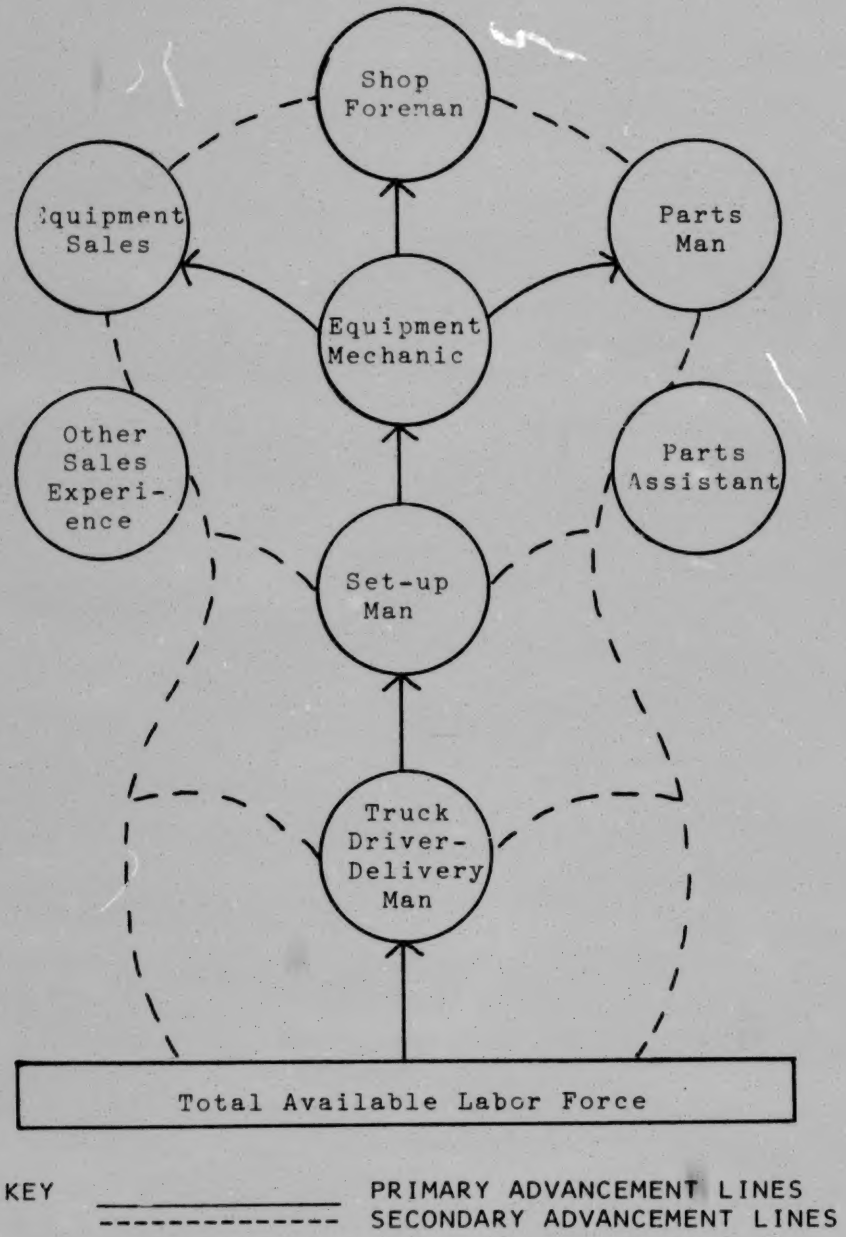
AND DEVELOPMENT BY STATE CURRICULUM PLANNERS, STATE SUPERVISORS AND TEACHERS IN DEVELOPING LOCAL PROGRAMS.

THE UNITS INCLUDED IN THIS GUIDE HAVE BEEN REVIEWED BY VARIOUS AGRICULTURAL EQUIPMENT AND MECHANICS INSTRUCTORS IN LOCAL PROGRAMS. THESE TEACHERS HAVE ALL HAD EXTENSIVE OCCUPATIONAL EXPERIENCE IN THE AGRICULTURAL EQUIPMENT AND MECHANICS INDUSTRY BEFORE BEGINNING THEIR TEACHING CAREERS.

ANOTHER PHASE OF THE VALIDATION PROCESS INCLUDED THE REVIEW OF THE GUIDE BY STATE AND NATIONAL CURRICULUM SPECIALISTS. THESE INDIVIDUALS ARE INVOLVED WITH DEVELOPING CURRICULUM MATERIALS FULL TIME AND PROVIDED VALUABLE INPUT FOR THE REVISION AND IMPROVEMENT OF THIS GUIDE.

THE UNITS HAVE ALSO BEEN REVIEWED BY PERSONNEL CURRENTLY EMPLOYED IN THE AGRICULTURAL EQUIPMENT AND MECHANICS INDUSTRY. IN ADDITION TO ASSISTING IN THE VALIDATION OF THE UNITS, THESE INDUSTRY PERSONNEL ALSO PROVIDED HELPFUL SUGGESTIONS AND COMMENTS AS THE UNITS WERE BEING DEVELOPED. IN SEVERAL INSTANCES, THEY ALSO REVIEWED THE COMPETENCY LISTS FOR ACCURACY AND COMPLETENESS.

FIGURE 1. MODEL OF ADVANCEMENT OPPORTUNITY IN AGRICULTURAL EQUIPMENT DEALERSHIPS.*


Shop Foreman
Equipment Sales
Parts Man
Equipment Mechanic
Other Sales Experience
Parts Assistant
Set-up Man
Truck Driver-Delivery Man
Total Available Labor Force
KEY
PRIMARY ADVANCEMENT LINES
SECONDARY ADVANCEMENT LINES

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* STITT, THOMAS R. "THE UNDERSTANDINGS AND ABILITIES NEEDED FOR SELECTED JOB TITLES OF FARM EQUIPMENT DEALERSHIPS IN OHIO." UNPUBLISHED PH.D. DISSERTATION, THE OHIO STATE UNIVERSITY, 1970.

I

AGRICULTURAL EQUIPMENT AND MECHANICS
U.S.O.E. CODE 01.03 01 00 00

AGRICULTURAL POWER SERVICE AND REPAIR

OCCUPATIONAL OPPORTUNITIES IN AGRICULTURAL EQUIPMENT AND MECHANICS

HUMAN RELATIONS IN THE AGRICULTURAL EQUIPMENT AND MECHANICS BUSINESS

DEVELOPING LEADERSHIP THROUGH FFA

AGRICULTURAL EQUIPMENT AND MECHANICS SALESMANSHIP AND SELLING

AGRICULTURAL EQUIPMENT DEALERSHIP BUSINESS ORGANIZATION PROCEDURES AND PRACTICES

SAFETY AND SANITATION PRACTICES IN AGRICULTURAL EQUIPMENT AND MECHANICS

EQUIPMENT, TOOLS AND HARDWARE USED IN AGRICULTURAL EQUIPMENT AND MECHANICS

USING SERVICE MANUALS AND COMMUNICATIONS EQUIPMENT

ELECTRIC WELDING IN AGRICULTURAL EQUIPMENT AND MECHANICS

OXY-ACETYLENE WELDING AND CUTTING

AGRICULTURAL EQUIPMENT BODY RECONDITIONING

TROUBLESHOOTING ENGINES

THE COMPRESSION SYSTEM OF SINGLE CYLINDER ENGINES

THE IGNITION SYSTEM OF SINGLE CYLINDER ENGINES

AGRICULTURAL POWER SERVICE AND REPAIR (CONTINUED)

THE CARBURETION SYSTEM OF SINGLE CYLINDER ENGINES

SERVICING AND REPAIRING THE OIL LUBRICATION SYSTEM ON SMALL GASOLINE ENGINES

THE ENGINE BLOCK AND HEAD

PISTON AND CONNECTING ROD ASSEMBLY

THE VALVE SYSTEM

CRANKSHAFT AND FLYWHEEL ASSEMBLY

THE ENGINE LUBRICATION SYSTEM

THE IGNITION SYSTEM

THE COOLING SYSTEM

THE GOVERNOR SYSTEM ON SPARK IGNITION ENGINES

THE GASOLINE FUEL SYSTEM

THE L-P GAS FUEL SYSTEM

THE DIESEL FUEL SYSTEM

THE ELECTRICAL SYSTEM

THE CLUTCH ASSEMBLY

THE TRANSMISSION SYSTEM

THE DIFFERENTIAL AND FINAL DRIVE ASSEMBLY

THE BRAKING SYSTEM

THE POWER TAKE-OFF ASSEMBLY

THE STEERING SYSTEM

THE HYDRAULIC SYSTEM

THE AIR CONDITIONING SYSTEM

WHEELS, TIRES, AND TRACKS

OCCUPATIONAL OPPORTUNITIES IN AGRICULTURAL EQUIPMENT AND MECHANICS

UNIT CONCEPT: THE FIELD OF AGRICULTURAL EQUIPMENT AND MECHANICS INCLUDES A BROAD SPECTRUM OF CAREER OPPORTUNITIES THE STUDENT MAY WISH TO EXPLORE. BY STUDYING THE VARIOUS OCCUPATIONS, THE STUDENT IS ABLE TO CONSIDER VARIOUS FACTORS SUCH AS WORKING CONDITIONS, SALARY AND REQUIREMENTS FOR ENTRY THAT WILL INFLUENCE HIS CAREER CHOICE.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. IN SEEKING INFORMATION ABOUT JOB OPPORTUNITIES, SURVEY OR OBTAIN LITERATURE INFORMATION WHICH WILL ASSIST HIM IN DETERMINING THE NUMBER AND KIND OF JOB OPPORTUNITIES THAT ARE AVAILABLE IN AGRICULTURAL EQUIPMENT AND MECHANICS.
2. GIVEN A SPECIFIC CAREER WHICH THE STUDENT IS INTERESTED IN, DETERMINE THE COMPETENCIES AND REQUIREMENTS NEEDED BY PERSONS TO ENTER AND ADVANCE IN THAT CAREER.
3. UPON DETERMINING THE REQUIREMENTS AND COMPETENCIES NEEDED TO ENTER A JOB, DEVELOP A PERSONAL PLAN WHICH WILL AID HIM IN ACQUIRING THE COMPETENCIES AND MEETING THE REQUIREMENTS NEEDED FOR ENTRY IN THAT JOB.
4. UPON IDENTIFYING A JOB IN WHICH HE IS INTERESTED, FOLLOW THE PROPER PROCEDURES NECESSARY TO BECOME PLACED ON THE JOB.
5. UPON SECURING PLACEMENT ON A JOB, WORK WITH OTHER EMPLOYEES, THE EMPLOYER AND CUSTOMERS IN A MANNER THAT WILL ENABLE THE STUDENT TO SUCCEED ON THE JOB.

B. INSTRUCTIONAL AREAS

1. ASSESSING THE JOB OPPORTUNITIES AVAILABLE IN AGRICULTURAL EQUIPMENT AND MECHANICS
    A. LOCATING INFORMATION REGARDING THE SCOPE OF AGRICULTURAL EQUIPMENT AND MECHANICS OCCUPATIONS AND THE OPPORTUNITIES FOR EMPLOYMENT

   B. SURVEYING THE LOCAL REGION FOR ENTRY LEVEL JOBS REGARDING THE NUMBER OF OPENINGS PER YEAR AND FUTURE EMPLOYMENT NEEDS

2. MAKING A DETAILED STUDY OF SELECTED AGRICULTURAL EQUIPMENT AND MECHANICS OCCUPATIONS

   A. DETERMINING WHAT PERSONAL INTERESTS ARE AND HOW THEY RELATE TO A SPECIFIC JOB OR CLUSTER OF OCCUPATIONS

   B. ASSESSING THE COMPETENCIES THAT ARE NEEDED FOR ENTRY

   C. DETERMINING THE EDUCATIONAL REQUIREMENTS NECESSARY FOR EMPLOYMENT

   D. ASSESSING THE PERSONAL TRAITS REQUIRED BY THE OCCUPATION

   E. DETERMINING THE WORKER BENEFITS IN A GIVEN OCCUPATION

   F. CONSIDERING FEDERAL AND STATE REGULATIONS WHICH APPLY TO VARIOUS OCCUPATIONS

3. DEVELOPING A PERSONAL PLAN FOR GAINING EXPERIENCES NECESSARY FOR GAINFUL EMPLOYMENT IN A GIVEN OCCUPATIONAL AREA

   A. PLANNING ACTIVITIES THAT WILL ENABLE THE STUDENT TO BE EXPOSED TO EXPERIENCES WHICH WILL AID IN HIS EMPLOYMENT

   B. WORKING WITH COOPERATORS IN DEVELOPING THE OCCUPATIONAL EXPERIENCE PROGRAM

   C. RECORDING THE ACTIVITIES IN THE OCCUPATIONAL EXPERIENCE PROGRAM

   D. SUPERVISING AND EVALUATING THE STUDENTS OCCUPATIONAL EXPERIENCE PROGRAM

4. SECURING A JOB BY FOLLOWING THE PROPER PROCEDURES INVOLVED IN JOB PLACEMENT

   A. LOCATING POTENTIAL JOBS THROUGH VARIOUS SOURCES

   B. ASSESSING THE JOB DESCRIPTION AND THE STUDENT'S INTERESTS

   C. APPLYING FOR A JOB

        (1) WRITING A LETTER OF APPLICATION
        (2) PREPARING A RESUME
        (3) SECURING REFERENCES

    D. CONDUCTING THE PERSONAL INTERVIEW

5. CONSIDERING FACTORS IMPORTANT TO JOB SUCCESS AND ADVANCEMENT

    A. ESTABLISHING RAPPORT WITH FELLOW EMPLOYEES, THE PUBLIC AND THE EMPLOYER

    B. PERSONAL GROOMING AND ITS IMPACT UPON THE PUBLIC, THE EMPLOYER AND FELLOW EMPLOYEES

    C. FOLLOWING DIRECTIONS AND WORKING INDEPENDENTLY IN AN OCCUPATION

    D. DEVELOPING DESIRABLE WORK HABITS

    E. CONTINUING SELF IMPROVEMENT ON THE JOB

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. CONDUCT A PERSONAL SURVEY BY PERSONAL CONTACT OR QUESTIONNAIRE OF REGIONAL AGRICULTURAL EQUIPMENT DEALERSHIPS TO DETERMINE THE NUMBER OF PERSONNEL EMPLOYEES IN VARIOUS JOBS IN AGRICULTURAL EQUIPMENT AND MECHANICS AND THE NUMBER OF OPENINGS EACH YEAR.

2. INTERVIEW SEVERAL PERSONS IN SPECIFIC OCCUPATIONS AND DETERMINE THE COMPETENCIES AND REQUIREMENTS NEEDED TO ENTER THE OCCUPATIONS.

3. VISIT THE MANAGER OF AN AGRICULTURAL EQUIPMENT DEALERSHIP AND DISCUSS WITH HIM THE FACTORS HE CONSIDERS IN HIRING AN EMPLOYEE FOR THE POSITION OR JOB THE STUDENT HAS INDICATED AS HIS OCCUPATIONAL CHOICE.

4. A. WRITE A LETTER OF APPLICATION, FILL OUT AN APPLICATION FORM, AND HAVE THE CLASS MEMBERS CRITIQUE IT.

    B. USING SIMULATION TECHNIQUES, HAVE THE STUDENTS ROLE PLAY JOB INTERVIEWS. RECORD THE INTERVIEWS ON A TAPE RECORDER AND HAVE EACH STUDENT CRITIQUE HIS OWN PRESENTATION. TO GUIDE THE STUDENTS IN THE CRITIQUE, HAVE THE CLASS DEVELOP A LIST OF CRITERIA FOR JOB INTERVIEWS AND CHECK THEMSELVES AGAINST THESE CRITERIA.

5. USING A PANEL COMPOSED OF EMPLOYERS AND EMPLOYEES, HAVE THE CLASS DISCUSS WITH THEM THE DEVELOPMENT AND MAINTENANCE OF WORKING RELATIONSHIPS BETWEEN EMPLOYEES AND EMPLOYER.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. A. HAVE THE STUDENTS LIST THREE TYPES OF PERSONS OR THREE SOURCES THEY MAY CONSULT OR CONTACT TO OBTAIN INFORMATION REGARDING JOB OPENINGS AND THE NUMBER OF OPENINGS.

   B. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE OF THE COLUMNS COULD BE VARIOUS JOB TITLES COMMONLY FOUND IN THE AGRICULTURAL EQUIPMENT AND MECHANICS INDUSTRY AND THE SECOND COLUMN COULD BE BRIEF JOB DESCRIPTIONS.

2. USING A MATCHING EXERCISE, HAVE THE STUDENTS MATCH THE COMPETENCIES NEEDED WITH THE APPROPRIATE JOB TITLE(S). THE COMPETENCIES THAT ARE LISTED TO BE USED FOR MATCHING PURPOSES SHOULD BE SPECIFIC ENOUGH TO ELIMINATE AS MUCH VAGUENESS AND AMBIGUITY IN THE COMPETENCY STATEMENTS AS POSSIBLE.

3. HAVE THE STUDENTS LIST FIVE EXPERIENCE PROGRAM ACTIVITIES IN WHICH THEY COULD PARTICIPATE THAT WOULD HELP THEM PREPARE FOR EMPLOYMENT IN THEIR DESIRED OCCUPATION.

4. A. GIVE EACH STUDENT A LETTER OF APPLICATION TO CRITIQUE. THIS LETTER OF APPLICATION SHOULD CONTAIN BOTH "GOOD" AND "BAD" PROCEDURES AND PRACTICES FOR PREPARING A LETTER OF APPLICATION. HAVE EACH STUDENT WRITE ON A SHEET OF PAPER THE "IMPROPER" PROCEDURES OR PRACTICES FOLLOWED IN THE LETTER OF APPLICATION AND HOW HE WOULD CHANGE THE LETTER OF APPLICATION WERE HE TO SUBMIT IT TO AN EMPLOYER.

   B. USING A VIDEO TAPE MACHINE, PLAY BACK TO THE STUDENTS A JOB INTERVIEW THAT A LOCAL EMPLOYER HAS CONDUCTED WITH A POTENTIAL EMPLOYEE. (TWO TEACHERS IN THE SCHOOL SYSTEM MAY BE USED TO SIMULATE THE JOB INTERVIEW.) HAVE THE STUDENTS LIST ON A PIECE OF PAPER THE "GOOD" AND "BAD" POINTS THEY OBSERVED IN THE JOB INTERVIEW. HAVE EACH STUDENT DISCUSS WHAT HE WOULD DO TO IMPROVE THE "BAD" POINTS OBSERVED IN THE INTERVIEW.

5. USING A CASE STUDY IN WHICH AN EMPLOYEE IS NOT "GETTING ALONG" WITH HIS FELLOW EMPLOYEES, THE CUSTOMERS AND HIS EMPLOYER, HAVE THE STUDENTS INDICATE WHAT PROCEDURES OR ACTIVITIES THE EMPLOYEE SHOULD FOLLOW IN ORDER TO RE-ESTABLISH GOOD WORKING RELATIONSHIPS WITH THE CUSTOMERS, EMPLOYEES AND EMPLOYER.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. SAMPLES OF JOB APPLICATION FORMS, LETTERS OF APPLICATION, OCCUPATIONAL SURVEY FORMS, PERSONAL CHARACTERISTICS CHECK LISTS, AND COPIES OF STATE AND FEDERAL LABOR REGULATIONS

2. APPROPRIATE TABLES, DESKS, CHAIRS AND TAPE RECORDER OR VIDEO TAPE MACHINES NECESSARY FOR CONDUCTING SIMULATED JOB INTERVIEWS

3. WRITTEN NOTICES FROM NEWSPAPERS, JOURNALS AND OTHER PUBLICATIONS LISTING VARIOUS JOBS OPENINGS

F. EXAMPLES OF SUPPORTING REFERENCES

1. AGRICULTURAL MECHANIZATION: A GUIDE FOR PLANNING OCCUPATIONAL PROGRAMS. ALBANY, NEW YORK: BUREAU OF SECONDARY CURRICULUM DEVELOPMENT, THE UNIVERSITY OF THE STATE OF NEW YORK. 1969, P. 7.

   A CURRICULUM GUIDE, THE TEACHER WILL FIND IN OUTLINE FORM THE VARIOUS AREAS OF INSTRUCTION THAT SHOULD BE COVERED IN EXPLORING OCCUPATIONS IN AGRICULTURAL EQUIPMENT AND MECHANICS.

2. BINKLEY, H. AND HAMMONDS, C. EXPERIENCE PROGRAMS FOR LEARNING VOCATIONS IN AGRICULTURE. DANVILLE, ILLINOIS: THE INTERSTATE PRINTERS AND PUBLISHERS, INC. 1970, PP. 45-69, 331-336, 423-444.

   THIS PUBLICATION PRESENTS AN OVERVIEW OF THE EXPERIENCE PROGRAM AND THE OPPORTUNITIES IN AGRICULTURAL EQUIPMENT AND MECHANICS THAT STUDENTS WILL FIND RELATIVELY EASY TO UNDERSTAND.

3. RESOURCE UNIT ON CAREER OPPORTUNITIES FOR CORE CURRICULUM. TUCSON, ARIZONA: DEPARTMENT OF AGRICULTURAL EDUCATION, THE UNIVERSITY OF ARIZONA. 1970, 10 PAGES.

   DEVELOPED IN AN OUTLINE FORMAT, THIS REFERENCE WILL BE HELPFUL TO THE INSTRUCTOR IN DEVELOPING QUESTIONS AND PROBLEMS FOR DISCUSSION. INCLUDED IS A LIST OF FILMSTRIPS AND STUDENT ACTIVITIES FOR EXPLORING AGRICULTURAL OCCUPATIONS.

4. WHY NOT BE A FARM TRACTOR AND IMPLEMENT PARTSMAN? COLLEGE STATION, TEXAS: DEPARTMENT OF AGRICULTURAL EDUCATION, TEXAS A & M UNIVERSITY. 1969, 6 PAGES.

A BRIEF SUMMARY OF THE WORK OF THE PARTSMAN, THE STUDENT WILL FIND THIS AN EASY-TO-UNDERSTAND INTRODUCTION TO THE REQUIREMENTS PLACED UPON THE PARTSMAN AND THE BENEFITS, INCLUDING MONETARY COMPENSATION, ONE MAY EXPECT.

HUMAN RELATIONS IN THE AGRICULTURAL EQUIPMENT AND MECHANICS BUSINESS

UNIT CONCEPT: MANY JOBS ARE LOST BECAUSE OF POOR HUMAN RELATIONS BETWEEN EMPLOYEE, CUSTOMER, EMPLOYER AND SUPERVISOR. HUMAN RELATIONS IN TODAY'S SOCIETY IS A "TWO-WAY STREET," AS THE EMPLOYEE HAS A ROLE OF RESPONSIBILITY AND LOYALTY TO THE EMPLOYER AND THE EMPLOYER HAS CERTAIN RESPONSIBILITIES TO THE EMPLOYEES. THE HUMAN RELATIONS PROCESS FOCUSES UPON THE ABILITY TO PRESENT IDEAS AND THE ABILITY TO LISTEN AS PEOPLE RELATE TO EACH OTHER.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. IDENTIFY SOME OF THE MAJOR CAUSES OF FAILURE ON THE JOB AND IDENTIFY SOME OF THE CRITERIA EMPLOYERS USE IN ADVANCING OR PROMOTING PERSONS SUCH AS DEPENDABILITY, PUNCTUALITY, PRODUCTION, INITIATIVE, COOPERATION, APPEARANCE AND COMPETENCE.

2. IN PREPARING FOR AN OCCUPATION IN AGRICULTURAL EQUIPMENT AND MECHANICS, COMPLETE TO THE SATISFACTION OF THE TEACHER, A SELF EVALUATION OF HIS PHYSICAL APPEARANCE, SPEECH AND CONVERSATION AND HIS PERSONALITY, AS IT RELATES TO RELATIONS WITH OTHER PERSONS.

3. IN PREPARING TO ENTER INTO AN OCCUPATION IN AGRICULTURAL EQUIPMENT AND MECHANICS, IDENTIFY THE EMPLOYEE'S ROLE, THE EMPLOYER'S ROLE, THE SUPERVISOR'S ROLE AND THE CUSTOMER'S ROLE IN THE BUSINESS TO THE SATISFACTION OF THE TEACHER.

4. WHEN WORKING WITH EMPLOYERS, FELLOW EMPLOYEES, SUPERVISORS, OR CUSTOMERS, COMMUNICATE EFFECTIVELY ORALLY OR IN WRITING WITH THESE PEOPLE TO THE SATISFACTION OF THE TEACHER AND/OR EMPLOYER.

5. WHILE EMPLOYED IN THE AGRICULTURAL EQUIPMENT AND MECHANICS BUSINESS, PROPERLY ANSWER AND USE THE TELEPHONE TO CONDUCT BUSINESS TRANSACTIONS TO THE SATISFACTION OF THE TEACHER AND/OR EMPLOYER.

B. INSTRUCTIONAL AREAS

1. DETERMINING WHY PEOPLE FAIL AND SUCCEED ON THE JOB

   A. IDENTIFYING COMMON CAUSES OF JOB FAILURE

      (1) CAUSES RELATED TO GENERAL HUMAN RELATIONS SKILLS
      (2) CAUSES RELATED TO TECHNICAL COMPETENCE

   B. IDENTIFYING THE VARIOUS HUMAN NEEDS AND MOTIVES THAT ARE SATISFIED BY OCCUPATIONS

   C. RECOGNIZING HOW THESE HUMAN MOTIVES AND NEEDS AFFECT THE HUMAN RELATIONS PROCESS

2. IDENTIFYING VARIOUS HUMAN RELATIONS SITUATIONS IN THE AGRICULTURAL EQUIPMENT AND MECHANICS BUSINESS

   A. ASSESSING THE EMPLOYEE'S ROLE IN THE BUSINESS

      (1) DETERMINING THE EMPLOYEE'S RESPONSIBILITY TO THE EMPLOYER, FELLOW EMPLOYEES AND SUPERVISOR
      (2) DETERMINING THE EMPLOYEE'S RESPONSIBILITY TO THE CUSTOMERS

   B. ASSESSING THE EMPLOYER'S ROLE IN THE BUSINESS

      (1) DETERMINING THE EMPLOYER'S RESPONSIBILITY TO THE EMPLOYEES
      (2) DETERMINING THE EMPLOYER'S RESPONSIBILITY TO THE FIRM'S CUSTOMERS

   C. ASSESSING THE SUPERVISOR'S ROLE IN THE BUSINESS

      (1) DETERMINING THE SUPERVISOR'S RESPONSIBILITY TO HIS EMPLOYER
      (2) DETERMINING THE SUPERVISOR'S RESPONSIBILITY TO THE EMPLOYEES
      (3) DETERMINING THE SUPERVISOR'S RESPONSIBILITY TO THE CUSTOMER

   D. ASSESSING THE CUSTOMER'S ROLE IN THE BUSINESS

3. CONSIDERING FACTORS THAT INFLUENCE THE HUMAN RELATIONS PROCESS IN AGRICULTURAL EQUIPMENT AND MECHANICS

   A. ASSESSING THE INFLUENCE OF PERSONALITY IN HUMAN RELATIONS

      (1) CONSIDERING FACTORS THAT INFLUENCE PERSONALITY
      (2) CONTROLLING AND IMPROVING YOUR PERSONALITY

B. RELATING TO YOUR FELLOW EMPLOYEES

(1) FEELINGS AND ATTITUDES THAT INFLUENCE PERSONALITY
(2) COOPERATING WITH FELLOW EMPLOYEES TO CREATE A PRODUCTIVE AND PLEASANT WORK ENVIRONMENT

C. RELATING TO YOUR SUPERVISORS

(1) IMPROVING ATTITUDES TOWARD SUPERVISION AND ACCEPTING CRITICISM, ADVICE AND PRAISE
(2) COOPERATING WITH YOUR SUPERVISORS IN RECOGNIZING AND SOLVING PROBLEMS THAT AFFECT THE BUSINESS ORGANIZATION

D. RELATING TO THE FIRM'S CUSTOMERS

(1) RECOGNIZING AND SOLVING PROBLEMS IN CUSTOMER RELATIONS
(2) FOSTERING THE DEVELOPMENT OF GOOD HUMAN RELATIONS WITH CUSTOMERS

4. COMMUNICATING WITH CUSTOMERS AND PERSONNEL IN THE BUSINESS

A. USING THE TELEPHONE EFFECTIVELY

(1) ANSWERING THE TELEPHONE
(2) TAKING TELEPHONE MESSAGES
(3) USING THE TELEPHONE AS A SALES TOOL

B. COMMUNICATING THROUGH WRITTEN MEDIA

(1) WRITING LETTERS TO CUSTOMERS
(2) TRANSMITTING MESSAGES THROUGH OFFICE MEMOS

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS CONDUCT A QUESTIONNAIRE SURVEY OF LOCAL AGRICULTURAL EQUIPMENT AND MECHANICS BUSINESSES AND DETERMINE THE MAJOR FACTORS OR REASONS FOR PERSONS LOSING THEIR JOBS DURING THE PAST FIVE YEARS.

2. HAVE EACH STUDENT COMPLETE A SELF INVENTORY OF HIS PERSONALITY AND COMPARE HIS RATINGS WITH THE RATINGS COMPLETED BY OTHERS.

3. HAVE A PERSONNEL MANAGER, A MANAGER OR A SUPERVISOR FOR AN AGRICULTURAL EQUIPMENT AND MECHANICS BUSINESS VISIT THE CLASS. HAVE THE STUDENTS AND GUEST DISCUSS THE IMPORTANCE OF ESTABLISHING GOOD HUMAN RELATIONS WITH THE EMPLOYER, FELLOW EMPLOYEE, CUSTOMER AND SUPERVISOR.

ADDITIONALLY, HAVE THE STUDENTS AND GUEST DISCUSS THE ROLE AND RESPONSIBILITY OF THE VARIOUS PERSONNEL WITHIN THE ORGANIZATION.

4. IN A CLASSROOM SIMULATION, HAVE THE STUDENT RECEIVE A MESSAGE OVER THE TELEPHONE FROM A CUSTOMER AND THEN RELAY THE MESSAGE TO ONE OF THE PERSONNEL BY USING AN OFFICE MEMO.

5. USING A TELEPHONE AND RECORDER, HAVE THE STUDENT RECORD A TELEPHONE CONVERSATION OF HIMSELF AND COMPELTE A SELF-RATING VOICE SCALE.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. HAVE THE STUDENTS LIST SOME OF THE MAJOR REASONS WHY EMPLOYEES LOSE THEIR JOBS SUCH AS LACK OF DEPENDABILITY, POOR PHYSICAL APPEARANCE, LACK OF COMPETENCE, LACK OF PUNCTUALITY AND OTHER REASONS.

2. HAVE EACH STUDENT COMPLETE A SELF INVENTORY OF HIS PHYSICAL APPEARANCE, SPEECH AND CONVERSATION AND PERSONALITY USING THE FORM "INVENTORY OF YOUR PERSONALITY" AS DESCRIBED IN RESOURCE UNIT ON HUMAN RELATIONS, TUCSON, ARIZONA: DEPARTMENT OF AGRICULTURAL EDUCATION, THE UNIVERSITY OF ARIZONA, 1971.

3. HAVE THE STUDENTS COMPLETE A MULTIPLE CHOICE AND TRUE OR FALSE EXERCISE WHICH FOCUSES ON THE ROLES AND RESPONSIBILITIES OF THE VARIOUS PERSONNEL IN THE AGRICULTURAL EQUIPMENT AND MECHANICS BUSINESS.

4. PRESENT THE STUDENTS WITH A CASE PROBLEM, A PART OF WHICH REPRESENTS A MEMO THAT AN EMPLOYEE TRANSMITTED TO THE EMPLOYER OR SUPERVISOR. HAVE THE STUDENTS CRITIQUE THE MEMO FOR SPELLING, PUNCTUATION, BREVITY AND CLARITY OF THOUGHT. HAVE THE STUDENTS INDICATE IN WRITING ANY CHANGES IN THE MEMO THEY WOULD MAKE.

5. HAVE THE STUDENTS LIST SOME OF THE "DO'S" AND "DON'TS" THAT NEED TO BE OBSERVED AND FOLLOWED WHEN USING THE TELEPHONE IN A BUSINESS.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. APPROPRIATE CLASSROOM EQUIPMENT SUCH AS TAPE RECORDER, TELEPHONE AND VIDEO TAPE EQUIPMENT.

2. APPROPRIATE FORMS FOR SELF EVALUATION SUCH AS INVENTORYING SHEETS FOR PERSONALITY, PHYSICAL CHARACTERISTICS, AND CASE PROBLEMS.

F. EXAMPLES OF SUPPORTING REFERENCES

1. COURSE OF STUDY IN AGRICULTURAL OCCUPATIONS. LEXINGTON, KENTUCKY: DEPARTMENT OF AGRICULTURAL EDUCATION, UNIVERSITY OF KENTUCKY. 1967, PP. 65-90.

   THIS REFERENCE, WHICH IS MOST HELPFUL TO TEACHERS, COVERS IN OUTLINE FORM THE VARIOUS AREAS OF HUMAN RELATIONS. VARIOUS FORMS ARE PROVIDED WHICH MAY BE COMPLETED IN EVALUATING THE HUMAN RELATIONS ASPECTS SUCH AS HUMAN RELATIONS WITH FELLOW WORKERS AND AN EMPLOYER-TEACHER EVALUATION.

2. HUMAN RELATIONS IN AGRI-BUSINESS. EAST LANSING, MICHIGAN: DEPARTMENT OF SECONDARY EDUCATION AND CURRICULUM, MICHIGAN STATE UNIVERSITY.

   THIS PUBLICATION IS INTENDED TO BE USED AS A STUDENT MANUAL FOR INDIVIDUALIZED INSTRUCTION. INCLUDED IS A BRIEF TEXT ON VARIOUS TOPICS IN HUMAN RELATIONS FOLLOWED BY STUDENT ACTIVITIES OR EXERCISES TO EVALUATE THE STUDENT'S COMPREHENSION OF THE TOPIC DICUSSSED.

3. HUMAN RELATIONS IN AGRICULTURAL OCCUPATIONS. MODULE NO. 3. COLUMBUS, OHIO: THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION, THE OHIO STATE UNIVERSITY. 1965, 31 PAGES.

   A TEACHER GUIDE, THIS PUBLICATION CONTAINS SUBJECT MATTER CONTENT FOR THE TEACHER WITH APPROPRIATE SUGGESTED LEARNING ACTIVITIES AND A MEANS OF EVALUATING STUDENT PERFORMANCE. VARIOUS CASES ARE PRESENTED WHICH THE TEACHER MAY WISH TO USE WITH STUDENTS ON VARIOUS ASPECTS OF HUMAN RELATIONS.

4. HUMAN RELATIONS IN BUSINESS. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1971, 69 PAGES.

   THE STUDENT REFERENCE INCLUDES BRIEF YET COMPREHENSIVE DISCUSSIONS AND EXERCISES, INCLUDING CASES, WHICH THE STUDENT CAN READ AND COMPLETE TO OBTAIN A BETTER UNDERSTANDING OF THE HUMAN RELATIONS PROCESS.

5. RESOURCE UNIT ON HUMAN RELATIONS. TUCSON, ARIZONA: DEPARTMENT OF AGRICULTURAL EDUCATION, THE UNIVERSITY OF ARIZONA. 1971, 90 PAGES.

IN THIS REFERENCE FOR TEACHERS, THE COMPLETE AREA OF HUMAN RELATIONS IS COVERED IN OUTLINE FORM. NUMEROUS CASE PROBLEMS ARE PRESENTED FOR STUDENTS AND TEACHERS TO CONSIDER DURING DISCUSSION PERIODS. VARIOUS RATING FORMS FOR SELF EVALUATION ARE INCLUDED WHICH THE STUDENTS MAY COMPLETE. SAMPLE TEST ITEMS ARE ALSO INCLUDED.

DEVELOPING LEADERSHIP THROUGH FFA

UNIT CONCEPT: ACTIVE PARTICIPATION IN THE FFA WILL PROVIDE THE STUDENT OPPORTUNITIES FOR DEVELOPING PRACTICAL TRAINING IN AGRICULTURE, LEADERSHIP, CO-OPERATION AND CITIZENSHIP.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. USING THE BASIC PRINCIPLES OF LEADERSHIP, IDENTIFY THE ROLE OF THE FFA ORGANIZATION IN AGRICULTURAL EQUIPMENT AND MECHANICS EDUCATION.

2. USING THE OFFICIAL FFA MANUAL, IDENTIFY THE HISTORY, AIMS AND PURPOSES AND ORGANIZATION OF THE FFA ON THE LOCAL, STATE AND NATIONAL LEVELS.

3. BY ACTIVELY PARTICIPATING IN THE ORGANIZATION'S BUSINESS MEETING, DEMONSTRATE THE PRINCIPLES OF PARLIAMENTARY PROCEDURE AS PRESENTED IN ROBERT'S RULES OF ORDER OR OTHER ACCEPTABLE REFERENCES.

4. THROUGH ACTIVE PARTICIPATION IN THE ORGANIZATION, SERVE EFFECTIVELY AS A COMMITTEE MEMBER AND/OR CHAIRMAN IN PLANNING AND CARRYING OUT THE CHAPTER PROGRAM OF ACTIVITIES.

5. IF ELECTED, SERVE EFFECTIVELY AS AN OFFICER IN THE ORGANIZATION BY FULFILLING THE DUTIES OF THE OFFICE TO WHICH ELECTED.

6. THROUGH CHAPTER AND CLASSROOM ACTIVITIES, DEVELOP EFFECTIVE PUBLIC SPEAKING SKILLS SO AS TO BE ABLE TO MAKE INTRODUCTIONS, PARTICIPATE IN CONVERSATIONS AND PREPARE AND DELIVER SPEECHES AND TALKS.

7. THROUGH ACTIVE PARTICIPATION IN THE FFA, DEVELOP A STRONG SELF CONCEPT AND A POSITIVE ATTITUDE TOWARD WORKING IN SOCIETY AS EVIDENCED BY HIS PUBLIC AND PRIVATE ACTIVITIES.

B. INSTRUCTIONAL AREAS

1. DEVELOPING LEADERSHIP

A. PURPOSES FOR ATTAINING LEADERSHIP SKILLS

B. TYPES OF LEADERSHIP

(1) FORMAL LEADERSHIP
(2) INFORMAL LEADERSHIP

C. QUALITIES OF LEADERSHIP

D. STYLES OF LEADERSHIP

E. FUNCTIONS OF DEMOCRATIC LEADERSHIP

F. OPPORTUNITIES FOR DEVELOPING LEADERSHIP ABILITIES

(1) HOME
(2) SCHOOL
(3) COMMUNITY
(4) FFA

2. DETERMINING THE PLACE OF FFA IN AGRICULTURAL EQUIPMENT AND MECHANICS EDUCATION

A. THE VALUES OF FFA MEMBERSHIP

B. THE CONTRIBUTION OF THE FFA TO THE SCHOOL AND COMMUNITY

3. DETERMINING THE BACKGROUND OF THE FFA

A. IMPORTANT HISTORICAL FACTS

B. AIMS AND PURPOSES

C. COLORS, EMBLEM, MOTTO AND CREED

4. GOVERNING AND FINANCING THE FFA

A. LOCAL

B. STATE

C. NATIONAL

5. ATTAINING FFA MEMBERSHIP AND DEGREES

A. TYPES OF MEMBERSHIP

B. LOCAL, STATE AND NATIONAL DEGREES

6. PLANNING AND CONDUCTING A CHAPTER MEETING

A. IDENTIFYING OFFICER RESPONSIBILITIES

B. IDENTIFYING MEMBER RESPONSIBILITIES

C. CONDUCTING THE BUSINESS MEETING

7. PLANNING AND CONDUCTING THE CHAPTER PROGRAM OF ACTIVITIES

A. IDENTIFYING AREAS TO BE INCLUDED

B. DEVELOPING A PROGRAM OF ACTIVITIES

C. CARRYING OUT THE PROGRAM OF ACTIVITIES

(1) IDENTIFYING CHAIRMAN RESPONSIBILITIES
(2) IDENTIFYING COMMITTEE MEMBER RESPONSIBILITIES

8. PERFORMING FFA OFFICER DUTIES AND RESPONSIBILITIES

A. IDENTIFYING QUALIFICATIONS FOR LOCAL, STATE AND NATIONAL OFFICES

B. IDENTIFYING SPECIFIC DUTIES OF EACH OFFICER

C.. DETERMINING GENERAL RESPONSIBILITIES OF AN OFFICER

(1) CONDUCTING CHAPTER PROGRAM
(2) PARTICIPATING IN OFFICER MEETINGS
(3) PARTICIPATING IN LEADERSHIP ACTIVITIES
(4) CONDUCTING CHAPTER MEETINGS

9. DEVELOPING PROFICIENCY IN PARLIAMENTARY PROCEDURE

A. PRESIDING OVER MEETINGS

B. PRESENTING MOTIONS CORRECTLY

10. DEVELOPING PUBLIC SPEAKING SKILLS

A. DEVELOPING CONVERSATION SKILLS

B. MAKING INTRODUCTIONS

C. PREPARING A SPEECH OR TALK

D. DELIVERING A SPEECH OR TALK

11. DETERMINING RESPONSIBILITIES OF FFA MEMBERS

A. DEVELOPING PERSONAL ATTRIBUTES

(1) PERSONAL APPEARANCE
(2) PROPER MANNERS
(3) BEHAVIOR IN PUBLIC

B. USING THE FFA CODE OF ETHICS

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. ANALYZE THE QUALITIES OF RECOGNIZED GOOD LEADERS.

2. ATTEND STATE AND/OR NATIONAL FFA CONVENTIONS TO OBSERVE THE OPERATION OF THE ORGANIZATION.

3. A. PARTICIPATE IN CLASSROOM STUDY AND PRACTICE OF PARLIAMENTARY PROCEDURE TO DEVELOP PARLIAMENTARY PROCEDURE SKILLS.

   B. PLAN AND POST AGENDA IN ADVANCE OF REGULAR CHAPTER MEETINGS TO PROMOTE ATTENDANCE AND PARTICIPATION BY ALL MEMBERS.

   C. ATTEND AND PARTICIPATE IN FFA MEETINGS TO DEVELOP LEADERSHIP ABILITIES.

   D. PREPARE FOR AND PARTICIPATE IN PARLIAMENTARY PROCEDURE DEMONSTRATIONS AND CONTESTS.

4. A. ACCEPT AN FFA COMMITTEE ASSIGNMENT SUITED TO INTEREST AND ABILITY TO DEVELOP SKILLS IN COMMITTEE WORK.

   B. SERVE AS A COMMITTEE CHAIRMAN TO DEVELOP LEADERSHIP SKILLS.

   C. PREPARE WRITTEN AND ORAL COMMITTEE REPORTS AND PRESENT THEM AT FFA MEETINGS TO DEVELOP PERSONAL SKILLS AND TO FACILITATE OPERATION OF THE ORGANIZATION.

   D. PARTICIPATE IN SPECIAL TRAINING PROGRAMS FOR COMMITTEE CHAIRMEN TO OBTAIN SKILLS IN COMMITTEE WORK.

5. A. ARRANGE FOR ELECTION OF FFA OFFICERS AND PARTICIPATE AS AN OFFICER IF ELECTED.

   B. PLAN, CONDUCT AND/OR PARTICIPATE IN LEADERSHIP WORKSHOPS OR OFFICER-TRAINING PROGRAMS.

   C. ESTABLISH PERFORMANCE STANDARDS FOR LOCAL FFA OFFICERS.

6. A. PARTICIPATE IN CLASSROOM DISCUSSIONS, DEMONSTRATIONS, ORAL AND WRITTEN REPORTS, AND LOCAL PUBLIC SPEAKING COMPETITION.

   B. ENTER PUBLIC SPEAKING CONTESTS ABOVE THE LOCAL LEVEL.

   C. PARTICIPATE IN LEADERSHIP ACTIVITIES ABOVE THE LOCAL LEVEL.

D. PRACTICE MAKING FORMAL INTRODUCTIONS THROUGH ROLE PLAYING.

E. HAVE EACH STUDENT PREPARE A SHORT TALK OR SPEECH TO PRESENT IN CLASS, USING A TAPE RECORDER OR VIDEOTAPE FOR THE STUDENT TO HEAR AND/OR OBSERVE HIS PERFORMANCE.

F. PREPARE AND/OR PARTICIPATE IN RADIO AND T.V. PROGRAMS RELATING TO FFA ACTIVITIES.

7. CONDUCT A SELF-EVALUATION OF LEADERSHIP QUALITIES, PERSONALITY CHARACTERISTICS, AND OTHER PERSONAL ATTRIBUTES, IDENTIFYING STRONG POINTS TO BUILD UPON AND WEAK POINTS NEEDING IMPROVEMENT.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. HAVE EACH STUDENT LIST THE QUALITIES OF A DEMOCRATIC LEADER SO THAT ATTAINMENT OF THE QUALITIES WOULD RESULT IN A PERSON DISPLAYING DEMOCRATIC LEADERSHIP.

2. DEVELOP A MATCHING TEST IN WHICH EACH STUDENT WOULD MATCH THE PARTS OF THE FFA EMBLEM WITH WHAT IT SYMBOLIZES WITH COMPLETE ACCURACY.

3. DIVIDE THE CLASS INTO GROUPS TO PRESENT A BUSINESS MEETING. THE TEACHER SHOULD EVALUATE EACH GROUP AND MEMBER AS TO THEIR POISE AND KNOWLEDGE OF PARLIAMENTARY PROCEDURE.

4. HAVE EACH MEMBER ASSIGNED RESPONSIBILITIES FOR ASSISTING IN PLANNING AND CONDUCTING THE CHAPTER PROGRAM OR ACTIVITIES. EVALUATE EACH MEMBER IN REFERENCE TO COMPLETION OF HIS ASSIGNED TASKS AND THE IMPROVEMENT THAT HE EXHIBITS OVER EACH GRADING PERIOD.

5. HAVE THE SECRETARY, TREASURER, AND REPORTER REGULARLY SUBMIT THEIR BOOKS TO THE AUDITING COMMITTEE AND TEACHER FOR EVALUATION AS TO COMPLETENESS, NEATNESS, AND ACCURACY.

6. CONDUCT A PUBLIC SPEAKING CONTEST IN EACH CLASS FOR THE TEACHER TO EVALUATE EACH STUDENT FOR HIS PRESENTATION IN RELATION TO HIS SPEAKING ABILITIES.

7. HAVE EACH STUDENT COMPLETE A PERSONAL EVALUATION FORM AS TO HIS ATTITUDES TOWARD HIMSELF AND SOCIETY. THE TEACHER SHOULD PRIVATELY DISCUSS THE PERSONAL EVALUATION WITH EACH STUDENT TO RECOGNIZE STRONG POINTS AND WEAK POINTS NEEDING IMPROVEMENT.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. OFFICIAL FFA PARAPHERNALIA
2. OFFICIAL FFA SECRETARY'S AND TREASURER'S BOOKS
3. OFFICIAL FFA SCRAPBOOK
4. TAPE RECORDER OR VIDEO-TAPE

F. EXAMPLES OF SUPPORTING REFERENCES

1. BENDER, RALPH E. THE FFA AND YOU. DANVILLE, ILLINOIS: THE INTERSTATE PRINTERS AND PUBLISHERS, INC. 1962, 494 PAGES.

   THIS TEXT COVERS ALL AREAS OF FFA PROGRAM ACTIVITIES AS WELL AS OFFICER AND MEMBER DUTIES AND RESPONSIBILITIES. AN EXCELLENT REFERENCE FOR BEGINNING MEMBERS AND OFFICERS.

2. MEMBERSHIP - THE PATHWAY TO LEADERSHIP. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1972, 12 PAGES.

   AN AID FOR TEACHER UNIT PLANNING AND FOR THE STUDENT, THIS BOOKLET EMPHASIZES FUNDAMENTAL LEADERSHIP COMPETENCIES TO BE DEVELOPED BY ALL MEMBERS.

3. OFFICIAL MANUAL, FUTURE FARMERS OF AMERICA. ALEXANDRIA, VIRGINIA: FUTURE FARMERS SUPPLY SERVICE. 1972, 129 PAGES.

   THIS MANUAL WILL ASSIST BOTH MEMBERS AND ADVISORS IN GAINING AN UNDERSTANDING OF THE HISTORY, ORGANIZATION, AND OPERATION OF THE FFA.

4. STEWART, W.F. HELPS IN MASTERING PARLIAMENTARY PROCEDURE. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1969, 27 PAGES.

   A SIMPLE AND EASILY UNDERSTOOD BOOKLET CONTAINING THE BASIC RULES OF PARLIAMENTARY PROCEDURE. IT ALSO INCLUDES A QUICK REFERENCE CHART WITH REQUIREMENTS FOR EACH TYPE OF MOTION.

AGRICULTURAL EQUIPMENT AND MECHANICS

SALESMANSHIP AND SELLING

UNIT CONCEPT: EFFECTIVE SELLING IN TODAY'S COMPLEX SOCIETY PROVIDES THE CORNERSTONE TO THE SUCCESS OF AN AGRICULTURAL EQUIPMENT BUSINESS WHETHER IT INVOLVES THE SELLING OF EQUIPMENT, PARTS AND/OR SERVICES. ALL EMPLOYEES WHO ARE SKILLED IN THE ART OF SALESMANSHIP AND FOCUS THEIR ATTENTION ON THE NEEDS OF THE CUSTOMER CAN AID IN THE DEVELOPMENT OF A SATISFIED CUSTOMER AND IN THE BUILDING OF "REPEAT BUSINESS."

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHILE WORKING IN THE AGRICULTURAL EQUIPMENT DEALERSHIP, HANDLE THE OBJECTIONS AND COMPLAINTS OF A CUSTOMER TO THE SATISFACTION OF THE TEACHER AND/OR EMPLOYER.

2. WHILE WORKING IN THE AGRICULTURAL EQUIPMENT DEALERSHIP, FILL OUT THE APPROPRIATE SALES FORMS USED BY THE BUSINESS TO THE SATISFACTION OF THE EMPLOYER.

3. WHILE WORKING IN THE AGRICULTURAL EQUIPMENT DEALERSHIP, ADVERTISE AND DISPLAY ITEMS FOR SALE IN A MANNER ACCEPTABLE TO THE TEACHER AND/OR EMPLOYER.

4. UPON THE REQUEST OF THE TEACHER, DEFINE SUBSTITUTE SELLING AND RELATED SELLING AND COMPLETE A WASHOUT SHEET AT A LEVEL OF PERFORMANCE ACCEPTABLE TO THE TEACHER.

5. WHILE WORKING IN THE AGRICULTURAL EQUIPMENT DEALERSHIP, MEET PROSPECTIVE CUSTOMERS AND CONDUCT A SALES PRESENTATION TO THE SATISFACTION OF THE TEACHER AND/OR EMPLOYER.

B. INSTRUCTIONAL AREAS

1. DETERMINING THE DUTIES AND RESPONSIBILITIES OF SALES PERSONNEL IN AGRICULTURAL EQUIPMENT AND MECHANICS
    - A. SELLING DUTIES AND RESPONSIBILITIES
    - B. NON-SELLING DUTIES AND RESPONSIBILITIES

    C. DETERMINING THE INFLUENCE NONSALES EMPLOYEES HAVE ON THE SALES OF A BUSINESS

2. ASSESSING THE ATTRIBUTES OF SUCCESSFUL SALES PERSONNEL
    A. DETERMINING THE INFLUENCE PERSONALITY HAS ON THE SALES PROCESS
    B. DETERMINING THE INFLUENCE THE SALESMAN'S MENTAL ATTITUDE HAS ON SELLING
    C. ASSESSING THE IMPORTANCE A SALESMAN'S PHYSICAL APPEARANCE HAS ON SELLING
    D. DETERMINING THE IMPORTANCE OF PRODUCT KNOWLEDGE IN THE SELLING PROCESS
3. ADVERTISING AND DISPLAYING ITEMS FOR SALE
    A. PREPARING ADVERTISING ANNOUNCEMENTS FOR VARIOUS MEDIA
    B. PREPARING DISPLAYS FOR SELLING ITEMS
4. APPROACHING AND MEETING THE POTENTIAL CUSTOMER
    A. CONSIDERING FACTORS THAT ARE IMPORTANT IN GREETING THE CUSTOMER
    B. HANDLING THE DIFFERENT KINDS OF CUSTOMERS
5. SECURING CUSTOMER ATTENTION AND INTEREST
    A. DEVELOPING METHODS TO SECURE CUSTOMER INTEREST
    B. MAINTAINING THE CUSTOMER'S INTEREST
6. HANDLING CUSTOMER OBJECTIONS
    A. IDENTIFYING THE CUSTOMER'S OBJECTION SUCH AS OBJECTIONS TO PRICE, ERRONEOUS IDEAS ABOUT THE PRODUCT, LACK OF A DESIRE TO CHANGE, TIME, AND SOURCE
    B. DETERMINING HOW TO HANDLE THESE OBJECTIONS AND STILL KEEP THE CUSTOMER INTERESTED
    C. SELLING SUBSTITUTE ITEMS AND/OR RELATED ITEMS
7. CLOSING THE SALE
    A. DETERMINING WHEN TO CLOSE THE SALE

B. USING VARIOUS TECHNIQUES FOR CLOSING THE SALE

C. RECORDING THE SALE AND COMPLETING THE APPROPRIATE FORMS USED BY THE BUSINESS

D. MAKING CHANGE AND USING THE CASH REGISTER

E. FOLLOWING-UP THE SALE

8. HANDLING CUSTOMER COMPLAINTS AFTER THE SALE HAS BEEN COMPLETED

A. DETERMINING WHAT THE COMPLAINT IS AND THE SOURCE OR CAUSE OF THE COMPLAINT

B. FOLLOWING APPROPRIATE PROCEDURES FOR HANDLING THE COMPLAINT OR REFERRING THE CUSTOMER TO APPROPRIATE PERSONNEL TO HANDLE THE COMPLAINT

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. VIDEO TAPE AN ACTUAL SITUATION IN AN AGRICULTURAL DEALERSHIP WHERE A CUSTOMER COMES INTO THE STORE WITH A COMPLAINT. PLAY THE TAPE UP TO THE POINT WHERE THE PERSON HEARING THE COMPLAINT DECIDES HOW TO HANDLE THE COMPLAINT. HAVE THE STUDENTS DISCUSS HOW THEY WOULD HANDLE THE COMPLAINT AND GIVE REASONS SUBSTANTIATING THEIR DECISIONS.

2. THROUGH SIMULATION PROCEDURES USING A CASH REGISTER AND APPROPRIATE SALES FORMS HAVE STUDENTS CLOSE A SALE AND COMPLETE THE APPROPRIATE FORMS.

3. A. HAVE STUDENTS PREPARE A SAMPLE DIRECT MAIL ADVERTISING ITEM THAT COULD BE USED BY THE SALES DEPARTMENT IN AN AGRICULTURAL EQUIPMENT DEALERSHIP.

B. USING VARIOUS PRODUCTS AND A DISPLAY COUNTER, HAVE STUDENTS SET UP AN INTERESTING DISPLAY OF THE PRODUCTS FOCUSING UPON ATTENTION GETTING TECHNIQUES.

4. USING SIMULATION PROCEDURES AND A DISPLAY COUNTER AND VARIOUS PRODUCTS, HAVE THE STUDENTS DEMONSTRATE THE USE OF SUBSTITUTE SELLING AND RELATED SALES ITEMS IN THE AGRICULTURAL EQUIPMENT DEALERSHIP.

. USING SAMPLE PRODUCTS AND A DISPLAY COUNTER, HAVE THE STUDENTS ROLE PLAY THE COMPLETE SALES PROCESS FOCUSING UPON GREETING THE CUSTOMER, MAINTAINING INTEREST, AND OVERCOMING CUSTOMER OBJECTIONS. HAVE THE STUDENTS DISCUSS AND CRITIQUE THE VARIOUS PRESENTATIONS.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. PRESENT THE STUDENTS WITH A CASE STUDY WHICH INCLUDES THE NATURE OF THE COMPLAINT AND THE CAUSE OF THE COMPLAINT. HAVE THE STUDENTS ROLE PLAY THE PROCEDURES THEY WOULD FOLLOW IN HANDLING THE COMPLAINT, AND EVALUATE THE STUDENT BY CONSIDERING FACTORS SUCH AS REFERRING TO AN APPROPRIATE PERSON WHEN NECESSARY, THE AMOUNT OF TIME TO RESOLVE THE CUSTOMER'S COMPLAINT AND DEGREE OF COURTESY EXHIBITED IN HANDLING THE COMPLAINT.

2. PRESENT EACH STUDENT WITH A COMPLETED SALES TICKET AND A CASH PAYMENT FROM THE CUSTOMER. HAVE EACH STUDENT MAKE CHANGE FOR THE CUSTOMER FROM THE CASH REGISTER. EVALUATE THE STUDENT BY CONSIDERING SUCH FACTORS AS WHETHER THE CORRECT CHANGE WAS MADE, THE TIME REQUIRED TO MAKE THE CHANGE, AND WHETHER THE CHANGE WAS MADE USING THE LEAST NUMBER OF "BILLS" AND "SILVER."

3. PRESENT THE STUDENTS WITH A PICTURE OR SKETCH OF A DISPLAY. HAVE THE STUDENTS INDICATE WHAT CHANGES THEY WOULD MAKE IF THEY WERE REDESIGNING THE DISPLAY AND SKETCH THEIR PROPOSED DISPLAY. EVALUATE THE STUDENT'S COMMENTS AND SKETCH CONSIDERING SUCH FACTORS AS EYE APPEAL OF THE DISPLAY, BALANCE OF THE DISPLAY, AND SIMPLICITY OF THE DISPLAY.

4. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN TERMS THAT THE STUDENT MAY ENCOUNTER WHEN INVOLVED IN THE AGRICULTURAL EQUIPMENT DEALERSHIP SUCH AS WASHOUT SHEET, RELATED SALES, AND SUBSTITUTE SELLING. A SECOND COLUMN SHOULD CONTAIN A SERIES OF DEFINITIONS WHICH PROPERLY DEFINE THE TERMS IN THE FIRST COLUMN.

5. PRESENT A VIDEO TAPE OF A SALES PRESENTATION FOR THE STUDENTS TO VIEW. AFTER VIEWING THE TAPE, HAVE THE STUDENTS CRITIQUE THE SALES PRESENTATION AND MAKE SUGGESTIONS AS TO HOW THEY WOULD CONDUCT THE SALES PRESENTATION. EVALUATE THE STUDENT'S SUGGESTIONS CONSIDERING THEIR SUGGESTED MEANS FOR OBTAINING THE CUSTOMER'S ATTENTION, GREETING THE CUSTOMER, AND OVERCOMING CUSTOMER OBJECTIONS.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. APPROPRIATE MATERIALS NEEDED FOR SIMULATION OF THE SALES PROCESS SUCH AS SALES FORMS, CASH REGISTER, AND DISPLAY COUNTER.

2. APPROPRIATE EXAMPLES OF ITEMS SOLD IN AGRICULTURAL EQUIPMENT DEALERSHIPS SUCH AS A UTILITY BLADE AND OTHER EQUIPMENT; ALSO RELATED PRODUCTS SUCH AS OIL, GREASE, OR TRACTOR SEAT CUSHIONS ARE SOLD IN THE AGRICULTURAL EQUIPMENT DEALERSHIPS.

F. EXAMPLES OF SUPPORTING REFERENCES

1. ADVERTISING AND PROMOTION. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1971, 32 PAGES.

   A STUDENT REFERENCE AND WORKBOOK, THIS REFERENCE SPECIFICALLY FOCUSES UPON THE PREPARATION OF ADVERTISING FOR VARIOUS MEDIA AND THE PREPARATION OF DISPLAYS. VARIOUS STUDENT ASSIGNMENTS AND EXERCISES ARE INCLUDED.

2. AGRICULTURAL SALESMANSHIP. COURSE OUTLINE FOR AGRICULTURAL MACHINERY - SERVICE OCCUPATIONS. COLUMBUS, OHIO: THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION, THE OHIO STATE UNIVERSITY. 1965, 32 PAGES.

   A TEACHER OUTLINE, THIS REFERENCE COVERS THE SECTIONS ON MEETING THE CUSTOMER, PRESENTING SUPPLIES AND SERVICES TO THE CUSTOMER, OVER-COMING CUSTOMER RESISTANCE, AND CLOSING THE SALE. INCLUDED IN THE OUTLINE ARE SUGGESTED TEACHING-LEARNING ACTIVITIES.

3. BUSINESS PRACTICES FOR AGRICULTURAL MACHINERY DEALERS. SHOP SERVICE, PART 2. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERISTY. 1969, 229 PAGES.

   A STUDENT REFERENCE AND WORKBOOK, PART 2 SPECIFICALLY ADDRESSES THE TOPIC OF SELLING EQUIPMENT, PARTS, AND SERVICE IN THE AGRICULTURAL EQUIPMENT DEALERSHIP. INCLUDED ARE STUDENT ASSIGNMENTS TO BE COMPLETED AND SAMPLE FORMS USED BY SALES PERSONNEL IN AGRICULTURAL EQUIPMENT DEALERSHIPS SUCH AS A WASHOUT SHEET, TRADE AGREEMENTS, PURCHASE ORDER FOR EQUIPMENT, LEASE AGREEMENTS, AND USED TRACTOR APPRAISAL AND RECONDITIONING CHECK LIST. A BRIEF SECTION ALSO COVERS THE USE OF DEMONSTRATIONS AND DISPLAYS IN AGRICULTURAL EQUIPMENT SALES.

4. SALESMANSHIP IN AGRICULTURAL BUSINESS. VAS 6002. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1972, 12 PAGES.

THIS REFERENCE WHICH IS USEFUL TO STUDENTS, PRESENTS AN OVERVIEW OF THE OPPORTUNITIES IN SALES IN AGRICULTURAL BUSINESS AND THE IMPORTANCE OF SELLING IN OUR ECONOMY. SECTIONS COVERED IN THE REFERENCE DEAL WITH THE PERSONAL CHARACTERISTICS OF SALES PERSONNEL, CONDUCTING THE SALES INTERVIEW, HANDLING OBJECTIONS, AND CLOSING THE SALE.

5. SELLING AND SALESMANSHIP. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1971, 32 PAGES.

A STUDENT REFERENCE AND WORKBOOK, THIS REFERENCE COVERS THE AREAS OF SUCCESSFUL SELLING, THE ACTUAL SALES TRANSACTION, AND THE LOST SALE. INCLUDED THROUGHOUT ARE EXERCISES WHICH THE STUDENT MAY COMPLETE ON VARIOUS TOPICS.

AGRICULTURAL EQUIPMENT DEALERSHIP BUSINESS ORGANIZATION PROCEDURES AND PRACTICES

UNIT CONCEPT: LIKE ANY INSURANCE POLICY THAT PROTECTS THE BUSINESS FROM FIRES AND OTHER HAZARDS, SO A GOOD BUSINESS PROCEDURES AND ACCOUNTING SYSTEM MAY PROTECT THE DEALER'S INVESTMENT FROM THE HAZARDS OF BUSINESS MISMANAGEMENT. A PERSON WHO IS AWARE OF THE BUSINESS ORGANIZATION AND THE OPERATING PROCEDURES IN THE PARTS DEPARTMENT, SERVICE DEPARTMENT, AND EQUIPMENT SALES DEPARTMENT MAY PROVIDE SERVICE TO THE CUSTOMERS IN A MORE EFFICIENT AND EFFECTIVE MANNER AND THUS AID IN MAINTAINING GOOD CUSTOMER RELATIONS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. IN CONSIDERING A SPECIFIC AGRICULTURAL EQUIPMENT DEALERSHIP, DESCRIBE THE ORGANIZATION OF PERSONNEL IN THE VARIOUS DEPARTMENTS AND THE ROLE OF EACH PERSON AT A LEVEL OF PERFORMANCE ACCEPTABLE TO THE TEACHER.

2. WHILE WORKING IN THE PARTS DEPARTMENT, BIN AND STORE PARTS, MAINTAIN INVENTORY RECORDS, AND COMPLETE CUSTOMER'S PARTS ORDERS WITH COMPLETE ACCURACY OR AT A LEVEL OF PERFORMANCE SATISFACTORY TO THE PARTS MANAGER OR EMPLOYER.

3. WHILE WORKING IN THE EQUIPMENT SALES DEPARTMENT, ASSIST THE SALESMAN IN COMPLETING THE VARIOUS EQUIPMENT SALES RECORDS USED BY A BUSINESS AT A LEVEL OF PERFORMANCE SATISFACTORY TO THE SALES MANAGER.

4. WHILE WORKING IN THE SERVICE DEPARTMENT, FOLLOW THE INSTRUCTIONS AS OUTLINED ON A SHOP SERVICE TICKET PREPARED BY THE SERVICE MANAGER, COMPLETE THE TIME PORTION OF THE TICKET, AND REQUEST ADDITIONAL PARTS FROM THE PARTS DEPARTMENT USING THE APPROPRIATE PROCEDURES TO THE SATISFACTION OF THE EMPLOYER.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING THE ORGANIZATIONAL PATTERNS OF THE AGRICULTURAL EQUIPMENT BUSINESS

A. DETERMINING THE PURPOSES OF THE VARIOUS DEPARTMENTS IN THE AGRICULTURAL EQUIPMENT BUSINESS

(1) THE EQUIPMENT SALES DEPARTMENT
(2) THE PARTS DEPARTMENT
(3) THE SERVICE DEPARTMENT

B. DETERMINING THE RESPONSIBILITIES OF VARIOUS PERSONNEL IN THE VARIOUS DEPARTMENTS

C. FOLLOWING GENERAL BUSINESS PROCEDURES FOR THE BUSINESS

(1) FORMS USED BY A DEALERSHIP REQUIRED BY THE GOVERNMENT FOR SUCH THINGS AS TAXES
(2) FORMS USED BY A DEALERSHIP FOR THE MANUFACTURER
(3) FORMS USED BY THE COMPANY FOR RECORDING PERSONNEL TIME AND COMPUTING WAGES

2. FOLLOWING PROCEDURES AND PRACTICES USED IN THE PARTS DEPARTMENT

A. USING PARTS CATALOGS AND PRICE LISTS

(1) INDEXING CATALOGS AND PRICE LISTS
(2) IDENTIFYING THE APPROPRIATE PARTS FROM THE SHOP SERVICE TICKET OR A VERBAL DESCRIPTION
(3) FINDING AND DETERMINING PRICES OF PARTS

B. CONTROLLING THE PARTS INVENTORY

(1) PREPARING AND MAINTAINING INVENTORY RECORDS
(2) CALCULATING INVENTORY TURNOVER
(3) USING REORDER INDICATOR SYSTEMS

C. ORDERING PARTS FOR THE PARTS DEPARTMENT

(1) USING VARIOUS TYPES OF ORDERS
(2) FILLING IN THE ORDERS
(3) TRANSPORTING AND SHIPPING PARTS
(4) RECEIVING, BINNING, AND STORING PARTS

3. FOLLOWING PROCEDURES AND PRACTICES USED IN THE SERVICE DEPARTMENT

A. USING THE SHOP SERVICE ORDER

(1) INTERPRETING THE JOB(S) TO BE DONE FROM THE SERVICE ORDER
(2) USING THE PARTS NEEDED ON THE SHOP SERVICE TICKET AND REQUESTING ADDITIONAL PARTS NEEDED

(3) FILLING IN THE LABOR REPAIR TIME RECORD ON THE SHOP SERVICE ORDER

B. REFERRING REPAIR JOBS TO OTHER INDIVIDUALS OR SPECIALISTS

4. FOLLOWING PROCEDURES USED IN THE EQUIPMENT SALES DEPARTMENT

A. DETERMINING WHAT THE MARKET IS AND WHO THE CUSTOMERS ARE

B. COMPUTING PRICE AND SELLING MARGIN

C. APPRAISING USED MACHINERY AND EQUIPMENT AND FILLING OUT THE "WASHOUT SHEET"

D. SELLING NEW EQUIPMENT

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. DEVELOP A CHART SHOWING THE ORGANIZATIONAL STRUCTURE OF A SPECIFIC AGRICULTURAL EQUIPMENT BUSINESS AND DEFINE THE DUTIES AND RESPONSIBILITIES OF THE PERSONNEL IN THE EQUIPMENT SALES DEPARTMENT, PARTS DEPARTMENT, AND SERVICE DEPARTMENT.

2. A. USING THE PARTS CATALOGS AND PRICE LISTS AND GIVEN VERBAL INFORMATION IN A ROLE PLAYING SITUATION, WRITE UP THE CUSTOMER'S ORDER FOR PARTS BEING SURE TO INDICATE THE QUANTITY, THE PART NUMBER, AND THE PRICE.

B. HAVE THE STUDENTS FILL IN A BLANK INVENTORY CARD GIVEN INFORMATION REGARDING THE PART NUMBER, DESCRIPTION LIST PRICE, LOCATION, AND SALES HISTORY.

C. USING AN ORDER FORM AND DETAILED INFORMATION PROVIDED REGARDING THE INVENTORY OF PARTS, COMPLETE AN ORDER FORM FOR A STOCK TYPE ORDER.

3. HAVE THE STUDENTS COMPLETE A "WASHOUT SHEET" THAT IS USED WHEN A TRADE-IN HAS BEEN RECEIVED ON A NEW ITEM OF EQUIPMENT.

4. A. HAVE THE STUDENTS FILL IN THE STUDENTS TIME CARD BY USING AN ELECTRONIC TIME CLOCK. THIS TIME SHOULD BE KEPT FOR A PERIOD OF A WEEK WHILE THE STUDENTS ARE WORKING IN THE SHOP.

B. WHILE WORKING ON AGRICULTURAL EQUIPMENT IN THE SCHOOL SHOP COMPLETE THE TIME RECORD PART OF THE SHOP, SERVICE TICKET.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. HAVE THE STUDENTS MATCH THE RESPONSIBILITIES, DUTIES, AND PURPOSES OF THE VARIOUS DEPARTMENTS WITH THE APPROPRIATE DEPARTMENT SUCH AS THE PARTS DEPARTMENT, THE SERVICE DEPARTMENT, AND THE EQUIPMENT SALES DEPARTMENT. THE STUDENTS SHOULD COMPLETE THE EXERCISE AT A LEVEL OF PERFORMANCE ESTABLISHED BY THE LOCAL TEACHER.

2. PROVIDE THE STUDENTS WITH INFORMATION REGARDING THE PART NUMBER, DESCRIPTION, LIST PRICE, LOCATION, AND SALES HISTORY. HAVE THE STUDENTS COMPLETE AN INVENTORY CARD AND SUBMIT IT FOR EVALUATION. THE STUDENT SHOULD COMPLETE THE CARD WITH 100% ACCURACY OR AT A LEVEL OF PERFORMANCE SATISFACTORY TO THE TEACHER.

3. PROVIDE THE STUDENTS WITH INFORMATION REGARDING A TRADE-IN ON NEW EQUIPMENT AND A "WASHOUT SHEET." HAVE THE STUDENTS COMPUTE THE CORRECT ACTUAL NET PROFIT OR LOSS ON THE DEAL.

4. PROVIDE THE STUDENTS WITH A TIME TICKET WHICH HAS THE TIME PUNCHED FOR VARIOUS JOBS A MECHANIC WOULD PERFORM DURING THE DAY. THE STUDENTS SHOULD USE INFORMATION PROVIDED IN A CASE STUDY FORMAT TO PROPERLY FILL IN WITH COMPLETE ACCURACY THE CUSTOMERS NAME, THE REPAIR ORDER NUMBER, THE DATE, THE EMPLOYEE, THE OPERATION, THE JOB NUMBER, AND WHETHER IT WAS OVERTIME OR REGULAR TIME.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EXAMPLES OF VARIOUS FORMS USED FOR INVENTORYING, ORDERING PARTS, ORDERING CUSTOMER PARTS, TIME CARDS, SHOP SERVICE ORDER, AND "WASHOUT SHEETS."

2. COPIES OF PARTS CATALOGS AND PRICE LISTS FOR THE STUDENTS TO USE.

F. EXAMPLES OF SUPPORTING REFERENCES

1. AGRICULTURAL BUSINESS PROCEDURES. VAS 6004. VOCATIONAL AGRICULTURAL SERVICE, UNIVERSITY OF ILLINOIS. 32 PAGES.

   A USEFUL STUDENT REFERENCE, TOPICS COVERED IN THIS REFERENCE OF PARTICULAR INTEREST ARE ORDERING AND RECEIVING MERCHANDISE AND TAKING THE INVENTORY.

2. BUSINESS PRACTICES FOR AGRICULTURAL DEALERS: EQUIPMENT SALES, PART 3. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1969, 231 PAGES.

   A STUDENT REFERENCE AND WORKBOOK, THIS REFERENCE COVERS THE ROLE OF SALESMEN, COMPUTING SELLING AND PROFIT MARGIN, APPRAISING USED EQUIPMENT, AND SELLING NEW EQUIPMENT.

3. BUSINESS PRACTICES FOR AGRICULTURAL DEALERS: PARTS DEPARTMENT, PART 1. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1969, 100 PAGES.

   A STUDENT REFERENCE AND WORKBOOK, THIS REFERENCE COVERS THE PRACTICES AND PROCEDURES USED IN MOST PARTS DEPARTMENTS. VARIOUS EXAMPLES OF INVENTORY CARDS, CUSTOMERS SALES ORDERS FOR PARTS, AND ORDER FORMS ARE PRESENTED WITH APPROPRIATE STUDENT EXERCISES.

4. BUSINESS PRACTICES FOR AGRICULTURAL DEALERS: SHOP SERVICE, PART 2. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1969, 160 PAGES.

   A STUDENT REFERENCE AND WORKBOOK, THIS REFERENCE COVERS THE PRACTICES AND PROCEDURES USED IN MOST SERVICE DEPARTMENTS. VARIOUS EXAMPLES OF TIME CARDS AND SERVICE WORK ORDERS ARE PRESENTED WITH APPROPRIATE STUDENT EXERCISES.

5. FARM AND POWER EQUIPMENT RETAILER'S HANDBOOK. ST. LOUIS, MISSOURI: NATIONAL FARM AND POWER EQUIPMENT DEALERS ASSOCIATION. 1964, PP. 140-213, 371-454.

   A GENERAL REFERENCE, THE TEACHER AND STUDENT MAY FIND THIS A USEFUL REFERENCE FOR AN OVERVIEW OF THE BUSINESS ORGANIZATION AND PROCEDURES OF AGRICULTURAL EQUIPMENT BUSINESSES.

SAFETY AND SANITATION PRACTICES IN AGRICULTURAL EQUIPMENT AND MECHANICS

UNIT CONCEPT: THE DEVELOPMENT OF A SAFE WORKING ENVIRONMENT WHICH STRESSES BOTH THE HUMAN FACTORS AND THE MECHANICAL ELEMENTS SHOULD RESULT IN A WORKING SITUATION WHERE THOUGHTLESSNESS, CARELESSNESS, AND A LACK OF CONSIDERATION FOR OTHERS IS MINIMIZED. IN SUCH A WORK ENVIRONMENT, CO-WORKERS SHOULD HAVE A MINIMAL AMOUNT OF BODILY HARM AND MINIMAL DAMAGE SHOULD RESULT TO FACILITIES, MACHINERY AND TOOLS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN WORKING IN THE SCHOOL MECHANICS FACILITY OR ON THE JOB, EXHIBIT AND FOLLOW THE STANDARDS ESTABLISHED BY THE TEACHER AND/OR EMPLOYER REGARDING PROPER PERSONAL SAFETY PRECAUTIONS SUCH AS PERSONAL DRESS, CLEANLINESS, AND WORK HABITS.

2. WHEN ASKED TO LIFT AND TRANSFER VARIOUS OBJECTS, EXHIBIT PROPER METHODS OF LIFTING AND CARRYING USING A FORK LIFT TO MOVE OBJECTS BY FOLLOWING PROCEDURES IN THE FORK LIFT OPERATOR'S MANUAL.

3. WHEN ASKED TO USE VARIOUS CLEANING AGENTS, FOLLOW AND EXHIBIT PROPER SAFETY PRECAUTIONS IN USING SUCH AGENTS BY FOLLOWING PROCEDURES DESCRIBED BY THE TEACHER OR AS DETAILED ON THE COMMERCIAL SOLVENT CHEMICAL CONTAINER.

4. WHEN ASKED TO WORK ON A TASK THAT REQUIRES SPECIAL VENTILATION PRECAUTIONS TO BE OBSERVED, FOLLOW APPROPRIATE PROCEDURES DESCRIBED BY THE TEACHER TO INSURE THAT PROPER VENTILATION IS PROVIDED FOR THE TASK.

5. WHEN WORKING IN THE AGRICULTURAL EQUIPMENT DEALERSHIP OR IN THE SCHOOL LABORATORY, FOLLOW PROCEDURES DESCRIBED IN AGRIBUSINESS: METALWORKING, MONTGOMERY, ALABAMA: AGRICULTURAL EDUCATION SERVICE, ALABAMA STATE DEPARTMENT OF EDUCATION, TO PREVENT FIRES AND EXTINGUISH FIRES.

6. WHEN WORKING IN THE SCHOOL SHOP OR WHILE EMPLOYED IN INDUSTRY, INSPECT AND ADJUST SHOP EQUIPMENT SAFETY SHIELDS AS DESCRIBED IN THE OPERATION MANUAL FOR THE SHOP EQUIPMENT.

7. WHEN WORKING IN THE SCHOOL SHOP OR WHILE EMPLOYED IN INDUSTRY, INSPECT THE ELECTRICAL SYSTEM OF THE FACILITY, FOLLOW SAFETY PRECAUTIONS IN USING ELECTRICAL EQUIPMENT AND TOOLS IN A MANNER THAT WILL PREVENT SHOCK TO HIMSELF OR DAMAGE TO THE EQUIPMENT AND FACILITY.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING POTENTIAL SAFETY HAZARDS IN THE SHOP OR LABORATORY
    - A. IDENTIFYING POTENTIAL HAZARDS RELATED TO HUMANS
    - B. IDENTIFYING POTENTIAL HAZARDS RELATED TO MACHINES
    - C. IDENTIFYING POTENTIAL HAZARDS RELATED TO ELECTRICAL SYSTEMS
    - D. IDENTIFYING POTENTIAL HAZARDS RELATED TO FIRES
2. FOLLOWING PERSONAL SAFETY PRECAUTIONS WHILE WORKING IN THE SHOP
    - A. DEMONSTRATING PROPER DRESS FOR WORKING IN THE SHOP OR IN THE INDUSTRY
    - B. EXHIBITING PROPER WORK HABITS IN THE SHOP OR IN THE INDUSTRY
    - C. USING FIRST AID PRACTICES AND FOLLOWING PROCEDURES TO MINIMIZE BODILY INJURY
3. FOLLOWING PRACTICES TO MINIMIZE FIRE HAZARDS
    - A. STORING INFLAMMABLE MATERIALS
    - B. STORING WASTE MATERIALS
    - C. IDENTIFYING DIFFERENT TYPES OF FIRES AND USING FIRE EXTINGUISHERS
    - D. PROCEDURES TO FOLLOW IN CASES OF FIRE
4. PROVIDING ADEQUATE VENTILATION IN THE SHOP WHEN VARIOUS TASKS ARE PERFORMED

   A. PROVIDING ADEQUATE VENTILATION IN THE WELDING AREA
   B. PROVIDING ADEQUATE VENTILATION IN THE PAINTING AREA
   C. PROVIDING ADEQUATE VENTILATION WHEN RUNNING MACHINERY AND ELIMINATING CARBON MONOXIDE
   D. PROCEDURES TO FOLLOW WHEN PERSONS HAVE BEEN OVERCOME WITH FUMES

5. FOLLOWING GENERAL SHOP TOOL AND EQUIPMENT SAFETY PRECAUTIONS
   A. INSPECTING AND ADJUSTING GUARDS AND OTHER PROTECTION DEVICES ON SHOP TOOLS AND EQUIPMENT
   B. CHECKING THE ELECTRICAL CONNECTIONS ON SHOP EQUIPMENT AND TOOLS FOR DEFECTS AND CORRECTING SUCH DEFECTS
   C. CLEANING SHOP TOOLS AND EQUIPMENT
6. OBSERVING GENERAL SAFETY PRECUATIONS WHILE WORKING WITH ELECTRICAL TOOLS AND EQUIPMENT
   A. GENERAL SAFETY PRECAUTIONS TO OBSERVE IN WORKING WITH ELECTRICAL EQUIPMENT
   B. INSPECTING THE SERVICE FIXTURES, OUTLETS AND WIRING FOR DEFECTS
   C. REPLACING FUSES OR RESETTING CIRCUIT BREAKERS
   D. PROCEDURES TO FOLLOW IN ADMINISTERING FIRST AID TO ELECTRICAL SHOCK VICTIMS
7. LIFTING AND TRANSFERRING WEIGHT IN THE SHOP
   A. PRECAUTIONS TO OBSERVE WHEN LIFTING AND TRANSFERRING OBJECTS BY HAND
   B. SAFETY PRECAUTIONS TO OBSERVE IN USING JACKS AND HOISTS
   C. USING FORK LIFTS TO LIFT AND TRANSFER OBJECTS
8. OBSERVING SAFETY PRECAUTIONS IN WORKING WITH CLEANING AGENTS AND MAINTAINING A SANITARY WORK ENVIRONMENT
   A. SPECIAL PRECAUTIONS TO OBSERVE IN WORKING WITH VARIOUS CLEANING AGENTS

B. OBSERVING GENERAL SANITATION PRECAUTIONS WHEN WORKING ON AGRICULTURAL EQUIPMENT

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING SEVERAL STUDENTS FROM THE CLASS, HAVE THE STUDENTS DEMONSTRATE THE APPROPRIATE AND INAPPROPRIATE PERSONAL DRESS FOR WORKING IN THE AGRICULTURAL MECHANICS SERVICE ARE.

2. HAVE THE STUDENTS USE A HOIST AND FORK LIFT TO LIFT AND TRANSFER OBJECTS FROM ONE AREA TO ANOTHER. A SPECIAL EFFORT SHOULD BE MADE TO FOLLOW PROPER SAFETY PRECAUTIONS WHEN OPERATING THE FORK LIFT OR USING A HOIST.

3. HAVE THE STUDENTS WASH PARTS IN A LIQUID PARTS CLEANING TANK BEING SURE TO FOLLOW APPROPRIATE SAFETY PRECAUTIONS.

4. USING SMALL MICE IN CAGES WITH AND WITHOUT FANS FOR VENTILATION, HAVE SEVERAL STUDENTS DEMONSTRATE THE EFFECT OF "POOR" AND "GOOD" VENTILATION IN AN AREA WHERE A HIGH CONCENTRATION OF FUMES EXISTS.

5. USING VARIOUS MATERIALS SUCH AS WOOD OR GREASY METAL, SIMULATE A SMALL FIRE SITUATION WHICH MAY OCCUR IN A MECHANICS SHOP AND HAVE THE STUDENTS USE APPROPRIATE PROCEDURES TO COMPLETELY EXTINGUISH THE FIRE.

6. HAVE THE STUDENTS ADJUST SAFETY SHIELDS AND OTHER SAFETY DEVICES ON EQUIPMENT ACCORDING TO THE DIRECTIONS IN THE OPERATOR'S MANUAL.

7. HAVE THE STUDENTS INSPECT THE ELECTRICAL CONNECTIONS ON THE EQUIPMENT AND TOOLS IN THE SHOP FOR BENT PRONGS AND FRAYED OR DAMAGED WIRES.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. PRESENT THE STUDENTS WITH A SKETCH OF A PERSON WORKING IN THE MECHANICS SHOP AREA. THIS SKETCH SHOULD HAVE THE PERSON DRESSED "IMPROPERLY" FOR WORK IN THE MECHANICS SERVICE AREA. HAVE THE STUDENTS IDENTIFY THE CHARACTERISTICS OF THE CLOTHING THAT CONSTITUTE "INAPPROPRIATE" DRESS. EVALUATE THE STUDENTS ACCORDING TO THE NUMBER OF "INAPPROPRIATE" CHARACTERISTICS THEY IDENTIFY.

2. HAVE THE STUDENTS OPERATE A FORK LIFT TO TRANSFER OBJECTS FROM ONE AREA TO ANOTHER. EVALUATE THE STUDENTS ON THE MANNER IN WHICH THEY ATTACH THE OBJECTS TO BE LIFTED AND THE MANNER IN WHICH THEY OPERATE THE FORK LIFT.

3. HAVE THE STUDENTS LIST THE SAFETY EQUIPMENT OR MATERIALS THEY WOULD NEED WHEN USING A COMMERCIAL SOLVENT TO CLEAN PARTS IN A PARTS CLEANING TANK. EVALUATE THE STUDENT BY CONSIDERING THE COMPLETENESS OF THE LIST.

4. HAVE THE STUDENTS LIST ANY SPECIAL SAFETY PRECAUTIONS THEY WOULD FOLLOW TO AVOID CARBON MONOXIDE POISONING WHEN RUNNING AN ENGINE IN THE SHOP TO CHECK PERFORMANCE. EVALUATE THE STUDENTS BY CONSIDERING THE COMPLETENESS OF THE LIST AND APPROPRIATE EQUIPMENT NEEDED FOR THE SAFETY PRECAUTIONS.

5. DESCRIBE, IN A CASE STUDY, A FIRE WHICH HAS OCCURRED IN THE MECHANICS SHOP. HAVE THE STUDENTS LIST IN THE PROPER ORDER THE PROCEDURES THEY WOULD FOLLOW TO EXTINGUISH THE FIRE AND MINIMIZE DAMAGE OR INJURY TO OTHERS. EVALUATE THE STUDENT BY CONSIDERING THE ORDER OF THE PROCEDURES AND EQUIPMENT THE STUDENT WOULD USE.

6. HAVE THE STUDENTS ADJUST SAFETY SHIELDS ON TOOLS AND EQUIPMENT IN THE SHOP BY USING THE OPERATION MANUAL FOR THE EQUIPMENT. EVALUATE THE STUDENT BY CONSIDERING WHETHER THE ADJUSTMENT MEETS THE CRITERIA IN THE OPERATION MANUAL.

7. HAVE THE STUDENTS ATTACH A MALE OUTLET PLUG TO A CORD. EVALUATE THE STUDENTS' WORK BY CONSIDERING SUCH FACTORS AS STRIPPING OF WIRES, THE TYPE OF CONNECTION MADE TO THE TERMINALS AND WHETHER AN UNDERWRITER'S KNOT HAS BEEN MADE WHEN NEEDED.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. APPROPRIATE FIRST AID KIT, FIRE EXTINGUISHERS AND FIRE BLANKET
2. FULLY EQUIPPED AGRICULTURAL MECHANICS SHOP
3. REFERENCE MATERIALS FROM THE NATIONAL RED CROSS THAT DICUSSSES THE TREATING OF VARIOUS INJURIES
4. PRESERVED FINGER FROM LOCAL DOCTOR TO STRESS THE IMPORTANCE OF SAFETY
5. CAGES, FANS AND SMALL MICE

F. EXAMPLES OF SUPPORTING REFERENCES

1. AGRIBUSINESS: METAL WORKING. MONTGOMERY, ALABAMA: AGRICULTURAL EDUCATION SERVICE, ALABAMA STATE DEPARTMENT OF EDUCATION. PP. 1-3.

   A STUDENT STUDY GUIDE, VARIOUS STUDENT STUDY QUESTIONS ARE PRESENTED ON METAL WORKING SAFETY WITH APPROPRIATE LEARNING ACTIVITIES.

2. AGRICULTURE SHOP SAFETY: TEACHER'S GUIDE. CLEMSON, SOUTH CAROLINA: DEPARTMENT OF AGRICULTURAL EDUCATION, CLEMSON UNIVERSITY. 1969, 41 PAGES.

   THIS REFERENCE, WHICH CONTAINS BOTH GENERAL SAFETY PRECAUTIONS AND SPECIFIC SAFETY PRECAUTIONS FOR SPECIFIC TOOLS AND EQUIPMENT, INCLUDES SUGGESTED TEACHER DEMONSTRATIONS AND SUGGESTED SAFETY TEST QUESTIONS.

3. RURAL ACCIDENT PREVENTION BULLETIN: POWER TOOLS. CHICAGO, ILLINOIS: NATIONAL SAFETY COUNCIL. 4 PAGES.

   IN A VERY BRIEF MANNER, THIS PUBLICATION COVERS SUCH TOPICS AS COMMON HUMAN ERRORS LEADING TO POWER TOOL ACCIDENTS, ELECTRICAL SHOCK AND GENERAL SAFE OPERATING RULES FOR POWER TOOLS.

4. SAFETY IN THE AGRICULTURAL MECHANICS SHOP. VAS 3022. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1967, 24 PAGES.

   IN ADDITION TO COVERING GENERAL SAFETY PRECAUTIONS FOR THE SHOP, SPECIFIC REFERENCE IS MADE TO SAFETY PRECAUTIONS IN OPERATING VARIOUS ELECTRICAL TOOLS AND EQUIPMENT. SAFETY PRECAUTIONS FOR WORKING WITH ELECTRICITY AND FOR TRACTOR AND MACHINERY REPAIR ARE ALSO PRESENTED.

5. SAFETY IN YOUR FUTURE: A SAFETY GUIDE FOR PRE-EMPLOYMENT TRAINING. WASHINGTON, D.C.: U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE, U.S. GOVERNMENT PRINTING OFFICE. 24 PAGES.

   A GENERAL REFERENCE, THIS PUBLICATION COVERS SUCH AREAS AS ELECTRIC TOOLS, PERSONAL SAFETY AND PERSONAL PROTECTION DEVICES, HANDLING MATERIALS, FIRES AND ADMINISTERING FIRST AID. INCLUDED IS A TEST WHICH THE STUDENTS MAY COMPELTE.

EQUIPMENT, TOOLS, AND HARDWARE USED IN AGRICULTURAL EQUIPMENT AND MECHANICS

UNIT CONCEPT: THE PROPER SELECTION, USE, AND CARE OF HAND AND POWER TOOLS WHEN REPAIRING AND SERVICING AGRICULTURAL EQUIPMENT NOT ONLY WILL AID IN PERFORMING THE REPAIRS OR SERVICES IN AN EFFICIENT AND EFFECTIVE MANNER, BUT THE PROPER USE AND CARE OF THE TOOLS WILL ALSO AID IN EXTENDED TOOL LIFE. IN ADDITION, USING THE PROPER HARDWARE IN PLACES CALLED FOR IN THE SERVICE MANUAL WILL HELP DECREASE OPERATING PROBLEMS IN THE EQUIPMENT AND MINIMIZE BREAKAGE.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. GIVEN VARIOUS KINDS OF EQUIPMENT AND TOOLS USED IN AN AGRICULTURAL EQUIPMENT DEALERSHIP, CORRECTLY IDENTIFY THE TOOLS AND EQUIPMENT AND DESCRIBE THEIR USES BY USING PROPER NOMENCLATURE AS PRESENTED IN A TOOL CATALOGUE SUCH AS PUBLISHED BY TOOL DISTRIBUTING COMPANIES.
2. PRESENTED VARIOUS KINDS OF HARDWARE COMMONLY USED ON AGRICULTURAL EQUIPMENT, CORRECTLY IDENTIFY THE HARDWARE BY USING THE PROPER NOMENCLATURE AND DETERMINE WHERE AND WHEN TO USE THE HARDWARE AS SUGGESTED IN THE ASSEMBLY MANUAL.
3. PRESENTED SELECTED ITEMS OF TOOLS OR EQUIPMENT IN NEED OF REPAIR OR REQUIRING GENERAL MAINTENANCE, MAKE SUCH REPAIRS OR PERFORM SUCH GENERAL MAINTENANCE PROCEDURES AS DETAILED IN AN OPERATOR'S MANUAL FOR POWER TOOLS AND EQUIPMENT.

B. INSTRUCTIONAL AREAS

1. USING HAND TOOLS COMMONLY NEEDED IN AN AGRICULTURAL EQUIPMENT DEALERSHIP FOR SERVICING, REPAIRING, OR ASSEMBLING EQUIPMENT
    A. IDENTIFYING THE VARIOUS HAND TOOLS USING THE COMMON AND/OR PROPER NOMENCLATURE
    B. DETERMINING THE PROPER USES OF VARIOUS HAND TOOLS

- (1) GENERAL HAND TOOLS USED FOR ASSEMBLING AND DISASSEMBLING EQUIPMENT AND PERFORMING GENERAL MAINTENANCE AND SERVICE
- (2) TOOLS USED FOR MARKING AND MEASURING

  - (A) READING RULERS, TAPES, MICROMETERS AND OTHER MEASURING TOOLS USED IN AN AGRICULTURAL EQUIPMENT DEALERSHIP
  - (B) CONVERTING TO THE METRIC SYSTEM

- (3) TOOLS USED FOR BORING, DRILLING, AND TAPPING
- (4) TOOLS USED FOR CUTTING OR FILING
- (5) TOOLS AND EQUIPMENT USED FOR LIFTING, TRANSPORTING, AND CLAMPING
- (6) TOOLS AND EQUIPMENT USED FOR LUBRICATION

C. OBSERVING SAFETY PRECAUTIONS WHEN USING VARIOUS HAND TOOLS

- (1) PROCEDURES TO FOLLOW FOR PREVENTING INJURIES TO PEOPLE
- (2) PROCEDURES TO FOLLOW FOR PREVENTING DAMAGE TO THE HAND TOOLS AND EQUIPMENT

D. FOLLOWING GENERAL MAINTENANCE PROCEDURES IN RESTORING OR REPLACING DAMAGED TOOLS OR EQUIPMENT

- (1) RESTORING TOOLS FOR USE SUCH AS COLD CHISELS AND SCREWDRIVERS
- (2) REPLACING DAMAGED PARTS ON HAND TOOLS AND EQUIPMENT SUCH AS REPLACING HAMMER HANDLES, FILE HANDLES, OR PUTTING HYDRAULIC OIL IN THE FLOOR JACK

2. USING POWER TOOLS COMMONLY NEEDED IN AN AGRICULTURAL EQUIPMENT DEALERSHIP FOR SERVICING, REPAIRING, OR ASSEMBLING EQUIPMENT

A. IDENTIFYING THE VARIOUS POWER TOOLS AND EQUIPMENT USING THE PROPER AND/OR COMMON NOMENCLATURE

B. DETERMINING THE PROPER USES OF VARIOUS POWER TOOLS AND EQUIPMENT

C. OBSERVING SPECIAL SAFETY PRECAUTIONS IN OPERATING VARIOUS POWER TOOLS

D. FOLLOWING APPROVED PRACTICES IN SERVICING AND MAINTAINING VARIOUS POWER TOOLS AND EQUIPMENT

3. USING SPECIALIZED TOOLS AND EQUIPMENT NEEDED IN AGRICULTURAL EQUIPMENT SERVICE, REPAIR, AND ASSEMBLY

A. IDENTIFYING THE VARIOUS SPECIALIZED MECHANICS TOOLS AND EQUIPMENT SUCH AS TIMING LIGHTS, TACHOMETER, DYNAMOMETER, ETC.

B. DETERMINING THE PROPER USES OF SUCH SPECIALIZED EQUIPMENT

C. OBSERVING SPECIAL SAFETY PRECAUTIONS IN OPERATING AND USING SUCH SPECIALIZED EQUIPMENT

D. FOLLOWING APPROVED PRACTICES IN THE ADJUSTMENT, MAINTENANCE, AND CARE OF SPECIALIZED TOOLS AND EQUIPMENT

4. USING HARDWARE IN AN AGRICULTURAL EQUIPMENT DEALERSHIP

A. IDENTIFYING VARIOUS HARDWARE ITEMS USED ON AGRICULTURAL EQUIPMENT

B. DETERMINING THE PROPER USE OF VARIOUS ITEMS OF HARDWARE

C. PROCEDURES TO FOLLOW IN USING VARIOUS HARDWARE ITEMS IN ASSEMBLING, SERVICING, OR REPAIRING AGRICULTURAL EQUIPMENT.

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. A. HAVE THE STUDENTS REMOVE BROKEN STUDS FROM METAL USING THE APPROPRIATE SIZE SCREW EXTRACTOR AFTER DRILLING A PROPER SIZE HOLE INTO THE BROKEN STUD.

B. HAVE THE STUDENTS QUIZ EACH OTHER USING ACTUAL TOOLS OR FLASH CARDS OF TOOLS. THE STUDENTS SHOULD MAKE CERTAIN THE PROPER AND/OR COMMON NAME OF THE TOOL IS USED AND THE USE OR PURPOSE OF THE TOOL IS DESCRIBED.

2. HAVE THE STUDENTS IDENTIFY FROM A PILE OF VARIOUS HARDWARE ITEMS THE HARDWARE ITEMS CALLED FOR IN AN ASSEMBLY SHEET FOR A GIVEN ITEM OF AGRICULTURAL EQUIPMENT SUCH AS A MANURE SPREADER OR GRAIN ELEVATOR.

3. HAVE THE STUDENTS RESTORE A NICKED COLD CHISEL OR A CENTER PUNCH.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. A. HAVE THE STUDENTS USE A DRILL PRESS TO DRILL A 3/8" HOLE IN THE CENTER OF A 1/4" X 1" X 2" PIECE OF STEEL. EVALUATE THE STUDENTS PERFORMANCE BY CONSIDERING

THE SAFETY PROCEDURES THAT WERE FOLLOWED, THE SIZE OF THE HOLE, THE LOCATION OF THE HOLE, AND THE AMOUNT OF ROUGH METAL LEFT AROUND THE EDGES OF THE HOLE.

B. DEVELOP A COMPLETION AND MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. HAVE THE STUDENTS IDENTIFY TOOLS OR ITEMS OF EQUIPMENT AND THEN MATCH THE TOOL WITH A SECOND COLUMN WHICH CONTAINS THE USES OF THE TOOL. EVALUATE THE STUDENTS' LEVEL OF PERFORMANCE BY CONSIDERING WHETHER THE STUDENTS' SCORES MEET A PRE-ESTABLISHED LEVEL OF PERFORMANCE ESTABLISHED BY THE LOCAL TEACHER.

2. DEVELOP A MATCHING EXERCISE WHEREIN THE STUDENTS ARE ASKED TO IDENTIFY VARIOUS ITEMS OF HARDWARE COMMONLY USED IN ASSEMBLING AND SERVICING AGRICULTURAL EQUIPMENT. EVALUATE THE STUDENTS'PERFORMANCE ON THE QUIZ AGAINST A PRE-DETERMINED LEVEL OF PERFORMANCE ESTABLISHED BY THE TEACHER.

3. HAVE THE STUDENTS RECONDITION A NICKED COLD CHISEL OR CENTER PUNCH AND SUBMIT IT FOR EVALUATION.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. A COMPLETE LINE OF HAND AND POWER TOOLS AND EQUIPMENT NEEDED IN AN AGRICULTURAL EQUIPMENT AND MECHANICS HIGH SCHOOL PROGRAM.

2. A COMPLETE LINE OF HARDWARE ITEMS COMMONLY USED IN REPAIRING, SERVICING, AND ASSEMBLING AGRICULTURAL EQUIPMENT.

3. METAL OF VARIOUS SIZES FOR THE STUDENTS TO WORK WITH

4. CHARTS SHOWING VARIOUS TOOLS AND EQUIPMENT

5. OPERATOR'S MANUALS FOR POWER EQUIPMENT

6. TOOL CATALOGUES FROM VARIOUS TOOL DISTRIBUTING FIRMS

F. EXAMPLES OF SUPPORTING REFERENCES

1. ABC'S OF HAND TOOLS. DETROIT, MICHIGAN: PUBLIC RELATIONS STAFF, GENERAL MOTORS BUILDING. 28 PAGES.

   ANOTHER WELL ILLUSTRATED PUBLICATION, IT COVERS THE BASIC USES OF HAND TOOLS AND THEIR PRACTICAL APPLICATION TO THE AREA OF MECHANICS.

2. FUNDAMENTALS OF SERVICE: SHOP TOOLS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATION. 1971, 36 PAGES.

   WELL ILLUSTRATED, THIS PUBLICATION COVERS NUMEROUS HAND AND SPECIALIZED TOOLS AND ILLUSTRATES THEIR PROPER USE IN A MANNER THAT STUDENTS WILL FIND EASY TO FOLLOW.

3. GENERAL SHOP GUIDE FOR VOCATIONAL-AGRICULTURE STUDENTS. MONTGOMERY, ALABAMA: AGRIBUSINESS EDUCATION SERVICE, ALABAMA STATE DEPARTMENT OF EDUCATION. 1969, 179 PAGES.

   PRESENTED WITH NUMEROUS ILLUSTRATIONS, THIS REFERENCE CAN BE USED BY BOTH TEACHER AND STUDENT. INCLUDED IN ADDITION TO ILLUSTRATIONS OF VARIOUS TOOLS ARE SECTIONS DEALING WITH THE USE OF SUCH TOOLS, AND THE RECONDITIONING OF VARIOUS TOOLS.

4. OPERATOR'S MANUALS FOR VARIOUS POWER TOOLS AND EQUIPMENT

   THESE GENERALLY WILL PROVIDE INFORMATION REGARDING THE PROPER USE OF THE TOOL OR EQUIPMENT AND PROCEDURES FOR SERVICING THE TOOL OR ITEM OF EQUIPMENT.

5. POWER TOOL SAFETY AND OPERATION: WOODWORKING, METALWORKING, METALS AND WELDING. ST. PAUL, MINNESOTA: HOBAR PUBLICATIONS. 1973, 96 PAGES.

   THIS PUBLICATION COVERS THE OPERATIONAL PROCEDURES AND GENERAL SAFETY PRECAUTIONS THAT SHOULD BE OBSERVED IN OPERATING VARIOUS ITEMS OF EQUIPMENT IN A CONCISE MANNER.

6. PRINCIPLES AND PRACTICE OF PRECISION MEASUREMENT. NORTH KINGSTOWN, RHODE ISLAND: BROWN AND SHARPE MANUFACTURING COMPANY. 1967, 56 PAGES.

   AN INSTRUCTORS GUIDE, THIS REFERENCE OUTLINES IN DETAIL VARIOUS LESSON PLANS THAT THE TEACHER MAY FIND HELPFUL IN PREPARING STUDENTS TO WORK WITH VARIOUS PRECISION MEASUREMENT INSTRUMENTS.

7. TOOL IDENTIFICATION MANUAL. SAN LUIS OBISPO, CALIFORNIA: VOCATIONAL EDUCATION PRODUCTIONS, CALIFORNIA STATE POLYTECHNIC COLLEGE. 32 PAGES.

   INCLUDED IN THIS PUBLICATION ARE PICTURES OF VARIOUS HAND AND POWER TOOLS WITH A BRIEF DESCRIPTION OF THE USE OF THE TOOL. VARIOUS TYPES OF HARDWARE ITEMS ARE ALSO COVERED IN A SIMILAR MANNER.

8. TODD, JOHN D. USE AND ADJUSTMENT OF SELECTED STATIONARY SHOP EQUIPMENT. KNOXVILLE, TENNESSEE: AGRICULTURAL EDUCATION DEPARTMENT, UNIVERSITY OF TENNESSEE. 1968, 30 PAGES.

MORE USEFUL AS A TEACHERS REFERENCE THAN AS A STUDENT REFERENCE, THIS PUBLICATION COVERS THE BASIC OPERATING AND SAFETY PRECAUTIONS TO USE WITH VARIOUS ITEMS OF EQUIPMENT.

USING SERVICE MANUALS AND COMMUNICATIONS EQUIPMENT

UNIT CONCEPT: THE EMPLOYEE IN THE SHOP OR IN THE FIELD WHO CAN READ AND CORRECTLY INTERPRET SERVICE OR ASSEMBLY MANUALS MAY ENHANCE CUSTOMER-DEALER RELATIONS BY PROVIDING PROPER AND ACCURATE SERVICE IN AN EFFICIENT MANNER. IN ADDITION, WHEN REPAIRS OR SERVICE IS REQUIRED IN THE FIELD, THE OPERATION OF COMMUNICATIONS EQUIPMENT BETWEEN THE OFFICE AND THE MECHANIC CAN SAVE MUCH TIME AND MONEY BY ELIMINATING UNNECESSARY ROAD TRAVEL.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED EQUIPMENT THAT NEEDS TO BE REPAIRED OR SERVICED, LOCATE THE PROPER SERVICE MANUAL TO USE FOR WORKING ON THE EQUIPMENT.
2. USING A SERVICE OR ASSEMBLY MANUAL, DETERMINE THE PROPER LOCATION OF VARIOUS PARTS AND LOCATE THE PROPER ADJUSTMENTS TO MAKE ON VARIOUS PARTS OF THE EQUIPMENT.
3. PROVIDED A TWO-WAY RADIO, OPERATE THE EQUIPMENT IN ACCORDANCE WITH FEDERAL COMMUNICATIONS COMMISSION AND ADJUST FOR SQUELCH AND VOLUME.

B. INSTRUCTIONAL AREAS

1. READING AND INTERPRETING SERVICE AND ASSEMBLY MANUALS
    - A. DETERMINING THE PROPER MANUAL TO USE
        - (1) LOCATING THE EQUIPMENT OR MODEL NUMBER ON THE EQUIPMENT
        - (2) OBTAINING THE PROPER SERVICE MANUAL FROM THE FILES
        - (3) DETERMINING WHY IT IS ESSENTIAL TO USE THE CORRECT SERVICE AND ASSEMBLY MANUALS
    - B. USING THE PROPER MANUAL
        - (1) USING SKETCHES AND CHARTS IN THE MANUALS TO DETERMINE WHERE CERTAIN PARTS BELONG AND THE POSITION OF THE PARTS
            - (A) TYPES OF LINES USED ON SKETCHES AND CHARTS AND WHAT THEY MEAN

        (B) ABBREVIATIONS FOUND ON CHARTS AND SKETCHES

      (2) LOCATING SPECIFICATIONS FOR MAKING ADJUSTMENTS

        (A) SPECIFICATIONS AND TOLERANCES FOR SPECIFIC PARTS OR COMPONENTS
        (B) ABBREVIATIONS USED IN SPECIFICATION TABLES

      (3) STORING AND CARING FOR THE MANUAL

2. USING RADIO COMMUNICATIONS EQUIPMENT FOUND IN THE DEALER'S TRUCKS AND OFFICE

   A. TURNING ON THE RADIO

      (1) TURNING ON POWER AND ADJUSTING FREQUENCY
      (2) ADJUSTING THE VOLUME
      (3) ADJUSTING THE SQUELCH

   B. TRANSMITTING AND RECEIVING MESSAGES

      (1) MAKING CONTACT USING CALL LETTERS
      (2) TRANSMITTING THE MESSAGE AND SIGNING OFF

   C. OBSERVING FEDERAL COMMUNICATIONS COMMISSION RULES AND REGULATIONS IN USING RADIO EQUIPMENT

      (1) PURPOSE OF RULES FOR RADIO
      (2) LAWS AND REGULATIONS APPLYING TO THE OPERATION OF THE EQUIPMENT
      (3) LISCENSING REQUIRED FOR OPERATION

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. FOR THE EQUIPMENT BEING WORKED ON IN THE SHOP, HAVE THE STUDENTS OBTAIN THE PROPER SERVICE MANUAL, OR USE THE CORRECT SECTIONS OF SERVICE BULLETINS.

2. FOR THE EQUIPMENT STUDENTS ARE WORKING ON SUCH AS TRACTORS, HAVE THE STUDENTS DETERMINE THE PROPER INTAKE AND EXHAUST VALVE SETTING FROM THE SERVICE MANUAL.

3. USING TWO-WAY RADIOS, HAVE THE STUDENTS PRACTICE TRANSMITTING MESSAGES USING CALL NUMBERS TO CONTACT THE BASE STATION.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. CHECK THE STUDENTS WHILE THEY ARE WORKING IN THE SHOP TO DETERMINE IF THEY ARE USING THE CORRECT SERVICE OR ASSEMBLY MANUALS.

2. PROVIDE THE STUDENTS WITH AN ENGINE SPECIFICATION SHEET WHICH WOULD INCLUDE SUCH ITEMS AS VALVE ADJUSTMENTS, RING-END GAP AND ENGINE MODEL FOR VARIOUS TRACTORS. HAVE THE STUDENTS PROVIDE THE SPECIFICATIONS REQUESTED BY USING MANUALS, COMPLETE THE SPECIFICATION SHEET AND SUBMIT IT FOR EVALUATION.

3. HAVE THE STUDENTS OPERATE TWO-WAY RADIOS TO TRANSMIT MESSAGES. EVALUATE THE STUDENTS BY CONSIDERING SUCH FACTORS AS ELIMINATION OF EXCESSIVE SQUELCH, ADJUSTMENT OF VOLUME, CLARITY IN TRANSMISSION, AND ADHERENCE TO FEDERAL COMMUNICATIONS COMMISSION RULES AND REGULATIONS.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. SERVICE MANUALS
2. ASSEMBLY MANUALS
3. SLIDES OR PHOTOGRAPHS SHOWING VARIOUS IDENTIFICATION NUMBERS ON EQUIPMENT
4. BAND RADIO
5. TWO-WAY RADIOS
6. POWER SOURCE FOR RADIOS AND ANTENNAS
7. EQUIPMENT SUCH AS TRACTORS FOR THE STUDENTS TO WORK ON

F. EXAMPLES OF SUPPORTING REFERENCES

1. CITIZENS RADIO SERVICE BULLETIN #1001. DETROIT, MICHIGAN: FEDERAL COMMUNICATIONS COMMISSION.

   THIS REFERENCE PROVIDES THE GENERAL PROCEDURES TO FOLLOW IN USING AND MAINTAINING THE RADIO EQUIPMENT.

2. I & T SHOP SERVICE MANUALS. KANSAS CITY, MISSOURI: IMPLEMENT AND TRACTOR PUBLICATIONS, INC.

   THESE REFERENCE MATERIALS WILL PROVIDE SPECIFICATIONS THE STUDENTS WILL NEED FOR VARIOUS GASOLINE AND DIESEL ENGINES.

3. RULES AND REGULATIONS OF THE FCC, VOLUME VI. WASHINGTON, D.C.: SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE. 1966.

THIS REFERENCE SPELLS OUT THE VARIOUS LAWS AND REGULATIONS THAT NEED TO BE ADHERED TO IN THE OPERATION OF RADIO EQUIPMENT.

4. SERVICE MANUALS AND ASSEMBLY MANUALS.

THESE WILL CONTAIN CHARTS THE TEACHER AND STUDENTS CAN USE TO INTERPRET ASSEMBLY PROCEDURES OR TO LOCATE SPECIFICATIONS FOR SERVICE AND ADJUSTMENT OF ENGINES.

ELECTRIC WELDING IN AGRICULTURAL EQUIPMENT AND MECHANICS

UNIT CONCEPT: IN USING THE ELECTRIC WELDER TO REPAIR AGRICULTURAL EQUIPMENT, A PERSON MUST PAY PARTICULAR ATTENTION TO THE COMPOSITION OF THE METALS BEING WELDED, THE TYPE OF JOINT BEING WELDED, THE WELDING TECHNIQUES, THE SELECTION OF ELECTRODES, THE CONTROL OF DISTORTION AND SAFE OPERATING PROCEDURES TO PRODUCE A WELD OF SUFFICIENT STRENGTH FOR VARIOUS OPERATING CONDITIONS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED VARIOUS TYPES OF MATERIALS TO BE WELDED, CORRECTLY IDENTIFY THE TYPE OF METAL BY USING SIGHT, TEXTURE, AND/OR SPARK TEST RESULTS.

2. WHILE MAINTAINING THE PROPER ARC LENGTH, SELECTING THE PROPER CURRENT SETTING, MAINTAINING PROPER SPEED OF TRAVEL AND PROPER ELECTRODE ANGLE, RUN BEADS IN VARIOUS POSITIONS BY SELECTING THE PROPER ELECTRODE.

3. GIVEN THE METALS TO BE WELDED AND APPROPRIATE WELDING EQUIPMENT, FOLLOW AND EXHIBIT SAFE OPERATING PROCEDURES FOR ARC WELDING TO PREVENT INJURY TO STUDENTS OR DAMAGE TO THE WELDING EQUIPMENT.

4. GIVEN METALS TO BE WELDED AND THE APPROPRIATE WELDING EQUIPMENT, PREPARE THE METAL AND MAKE LAP, FILLET, AND BUTT WELDS IN THE FLAT, HORIZONTAL, VERTICAL AND OVERHEAD POSITIONS THAT WILL NOT BREAK UNDER THE OPERATING CONDITIONS OF THE EQUIPMENT BEING REPAIRED.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING THE METALS THAT MAY BE WELDED BY USING THE ARC WELDER

    A. IDENTIFYING BY SIGHT AND TEXTURE THE DIFFERENT KINDS OF IRON, STEEL, AND OTHER METALS SUCH AS ALUMINUM, BRASS, COPPER, AND ZINC-TIN COMBINATIONS (POT METAL) USED IN MAKING VARIOUS MACHINERY PARTS

        (1) EXAMINING THE NATURE OF THE BREAK AND TYPE OF BREAK

      (2) COLOR OF THE GRAIN
      (3) LISTENING TO THE RING OF THE METAL
      (4) TEXTURE OF THE METAL

   B. IDENTIFYING FERROUS METALS USED IN MAKING EQUIPMENT PARTS BY USING THE SPARK TEST

   C. DETERMINING HOW THE VARIOUS METALS MAY BE WELDED

2. PREPARING THE METAL FOR WELDING

   A. PRACTICES TO FOLLOW IN CLEANING THE METAL FOR WELDING

      (1) REMOVING EXCESSIVE DIRT AND GREASE
      (2) REMOVING RUST

   B. PROCEDURES TO FOLLOW IN PREPARING AND FITTING THE CLEANED PIECES FOR WELDING

   C. DETERMINING THE KIND OF JOINT AND WELD TO BE USED FOR A SPECIFIC SITUATION

   D. PRACTICES TO FOLLOW IN "SETTING-UP" THE METALS TO BE WELDED TO CONTROL FOR EXPANSION AND CONTRACTION OF METAL AND MINIMIZE DISTORTION

      (1) POSITIONING THE METAL
      (2) SECURING THE METAL IF NECESSARY

3. PREPARING AND OPERATING THE WELDING EQUIPMENT AND USING THE ACCESSORIES NEEDED FOR MAKING A WELD

   A. SELECTING THE ELECTRODE TO BE USED FOR MAKING A WELD

      (1) FACTORS TO BE CONSIDERED
      (2) PURPOSE OF ELECTRODE AND COMPOSITION OF ELECTRODE
      (3) IDENTIFYING ELECTRODES AS CODED BY THE AMERICAN WELDING SOCIETY AND AMERICAN SOCIETY FOR TESTING MATERIALS

   B. ADJUSTING THE CURRENT ON THE ARC WELDER FOR MAKING A WELD

      (1) FACTORS THAT NEED TO BE CONSIDERED IN SETTING THE AMPERAGE
      (2) SETTING THE AMPERAGE ON VARIOUS WELDERS

   C. SAFETY PRECAUTIONS THAT NEED TO BE CONSIDERED IN USING ARC WELDING EQUIPMENT

      (1) PERSONAL SAFETY PRACTICES TO FOLLOW
      (2) PREVENTING FIRES IN THE WELDING AREA

(3) INSPECTING THE EQUIPMENT AND SURROUNDING AREA FOR POTENTIAL HAZARDS

4. WELDING VARIOUS KINDS OF JOINTS IN VARIOUS POSITIONS

A. GENERAL PRECAUTIONS TO OBSERVE AND PRACTICES TO FOLLOW IN MAKING A "STRONG" WELD AND MINIMIZING WELD DEFECTS

(1) STARTING THE ARC
(2) DETERMINING WHAT FACTORS INFLUENCE THE STRENGTH OF A WELD
(3) RUNNING A BEAD

(A) MAINTAINING PROPER LENGTH OF ARC
(B) MAINTAINING PROPER FORWARD TRAVEL

(4) RE-ESTABLISH A BEAD
(5) DETERMINING WHAT INFLUENCE HEAT HAS ON METAL AND TAKING STEPS TO PREVENT DISTORTION

B. PRACTICES TO FOLLOW IN MAKING A WELD IN THE FLAT POSITION

C. PRACTICES TO FOLLOW IN MAKING WELDS IN THE VERTICAL POSITION

D. PRACTICES TO FOLLOW IN MAKING WELDS IN THE OVERHEAD POSITION

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. IDENTIFY VARIOUS KINDS OF METAL THAT MAY BE FOUND ON AGRICULTURAL EQUIPMENT. THE STUDENTS SHOULD INSPECT THE GRAIN OR TEXTURE OF THE METAL, THE COLOR OF THE METAL, AND USE A GRINDER TO CONDUCT A SPARK TEST. THE TEACHER SHOULD DEVELOP A DEMONSTRATION BOARD WHICH HAS THE VARIOUS KINDS OF METALS IDENTIFIED AND WHICH THE STUDENTS COULD USE AS A REFERENCE TO CHECK THEIR OWN IDENTIFICATION RESULTS.

2. A. RUN A SERIES OF 3 INCH LONG BEADS ON 1/4 INCH METAL. THE STUDENTS SHOULD RUN A BEAD FOR EACH OF THE FOLLOWING CONDITIONS TO DETERMINE WHAT EACH CONDITION HAS ON THE QUALITY OF THE WELD: (1) IMPROPER AMPERAGE SETTING, (2) IMPROPER ARC LENGTH, (3) IMPROPER SPEED OF TRAVEL, AND (4) IMPROPER ELECTRODE ANGLE.

B. PRACTICE RUNNING THREE 5-INCH LONG BEADS ON VARIOUS THICKNESSES OF METAL IN VARIOUS POSITIONS BEING SURE TO MAINTAIN PROPER ARC LENGTH, ELECTRODE ANGLE, SPEED OF TRAVEL, AND USE THE PROPER AMPERAGE SETTING.

3. BEFORE WELDING HAVE THE STUDENTS CHECK THE WELDING AREA FOR ANY SAFETY HAZARDS AND CHECK THE PERSONAL DRESS OF EACH STUDENT IN THE WELDING AREA FOR ANY POTENTIAL SAFETY HAZARDS.

4. A. CLEAN AND PREPARE 1/4 INCH METAL FOR WELDING A BUTT WELD IN THE FLAT POSITION.

   B. WELD A BUTT WELD IN THE FLAT POSITION USING A 1/4 INCH THICKNESS COPPER STRIP AS A BACK-UP STRIP WHERE IT IS NOT POSSIBLE TO GET A GOOD FIT-UP OF METALS TO BE WELDED AND THE JOINT HAS A LARGE GAP.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. PREPARE EXAMPLES OF SOME OF THE MORE COMMON KINDS OF METAL THAT ARE FOUND ON AGRICULTURAL EQUIPMENT. HAVE THE STUDENTS IDENTIFY THE METAL BY NAME AND INDICATE WHETHER IT CAN BE WELDED USING AN ARC WELDER. EVALUATE THE STUDENT BY CONSIDERING WHETHER THE METAL HAS BEEN NAMED CORRECTLY AND WHETHER IT CAN BE WELDED OR NOT WELDED WITH THE ARC WELDER.

2. THE STUDENTS SHOULD SUBMIT FOR EVALUATION FIVE THREE-INCH LONG BEADS ON 1/4 INCH THICKNESS METAL. THE TEACHER SHOULD EVALUATE THE BEADS CONSIDERING THE FACTORS SUCH AS AMPERAGE SETTING, LENGTH OF ARC, SPEED OF TRAVEL AND ANGLE OF ELECTRODE.

3. DEVELOP A "TRUE" OR "FALSE" SAFETY QUIZ ON ARC WELDING FOR THE STUDENTS TO COMPLETE. EVALUATE THE STUDENTS' PERFORMANCE ON THE BASIS OF COMPLETING THE TEST AT A CERTAIN LEVEL OF PERFORMANCE ESTABLISHED BY THE LOCAL TEACHER.

4. THE STUDENTS SHOULD SUBMIT FOR EVALUATION A LAP WELD MADE IN THE FLAT POSITION USING TWO PLATES OF 3/16 INCH THICKNESS METAL. THE TEACHER SHOULD EVALUATE THE STUDENTS' WORK ON THE BASIS OF THE AMOUNT OF SPATTER, THE DEGREE OF UNDERCUTTING, THE DEGREE OF OVERLAP, AND THE STRENGTH OF THE WELD.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. DIFFERENT TYPES OF METAL OF VARYING THICKNESS FOR THE STUDENTS TO WORK ON

2. A SUFFICIENT NUMBER OF ARC WELDERS AND BOOTHS FOR THE STUDENTS TO USE WITH ADEQUATE VENTILATION SYSTEM(S)

3. ARC WELDING ACCESSORIES INCLUDING GLOVES, WIRE BRUSH, GROUND CLAMP, ELECTRODE HOLDER, ELECTRODES, HEAD SHIELD, WELDING CABLES, CHIPPING HAMMER, PLIERS, WELDING APRONS, WELDING TABLES, AND GRINDER

4. CHARTS SHOWING THE CLASSIFICATION OF ELECTRODES, WHICH ELECTRODES TO USE IN VARIOUS SITUATIONS AND DETERMINING THE AMPERAGE SETTING

5. A DISPLAY BOARD WHICH HAS VARIOUS METALS IDENTIFIED

6. A DISPLAY OF VARIOUS TYPES OF WELDS SHOWING BOTH "GOOD" AND "BAD" WELDS

F. EXAMPLES OF SUPPORTING REFERENCES

1. ARC WELDING. VAS 3004. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1967, 40 PAGES.

   WELL ILLUSTRATED, THIS PUBLICATION COVERS A VAST ARRAY OF AREAS IN ARC WELDING WHICH THE STUDENT CAN READ IN A SHORT PERIOD OF TIME.

2. BALL, TOM. SOURCE UNIT IN ARC WELDING. DENVER, COLORADO: DEPARTMENT OF VOCATIONAL EDUCATION, COLORADO STATE UNIVERSITY. 1970, 59 PAGES.

   PRIMARILY A TEACHER'S REFERENCE, IT INCLUDES VARIOUS EXERCISES FOR STUDENTS AND A GENERAL OUTLINE OF STUDY QUESTIONS FOR STUDENT MOTIVATION.

3. FARM ARC WELDING PROCEDURES. COLLEGE STATION, TEXAS: TEXAS EDUCATION AGENCY, TEXAS A & M UNIVERSITY. 47 PAGES.

   MOST HELPFUL AS A TEACHER'S REFERENCE, THIS PUBLICATION SUGGESTS VARIOUS PROCEDURES AND EXERCISES THAT TEACHERS MAY USE IN TEACHING THE ARC WELDING AREA.

4. PHIPPS, LLOYD JAMES. FARM MECHANICS TEXT AND HANDBOOK. DANVILLE, ILLINOIS: THE INTERSTATE PRINTERS AND PUBLISHERS, INC. 1964, PP. 241-278.

   THIS REFERENCE COVERS THE BASIC WELDING OPERATIONS IN A MANNER THAT STUDENTS WILL FIND EASY TO UNDERSTAND.

5. TEACHER'S MANUAL: ARC WELDING INSTRUCTIONS FOR THE BEGINNER. CLEVELAND, OHIO: THE JAMES F. LINCOLN ARC WELDING FOUNDATION. 1964, 58 PAGES.

OF MOST VALUE TO THE INSTRUCTOR, THIS PUBLICATION COVERS THE VARIOUS AREAS OF ARC WELDING AND INCLUDES SUGGESTED DEMONSTRATIONS WHICH THE TEACHER WILL FIND USEFUL IN STRESSING VARIOUS CONCEPTS.

OXY-ACETYLENE WELDING AND CUTTING

UNIT CONCEPT: THE REPAIR OF AGRICULTURAL EQUIPMENT BY A PERSON USING THE OXY-ACETYLENE WELDING EQUIPMENT NECESSITATES THAT IT BE OPERATED SAFELY AND THAT THE PERSON UNDERSTAND THE PROPERTIES OF THE METALS TO BE WELDED, THE TYPES OF FLAMES TO BE USED, AND THE TYPES OF FILLER RODS TO BE USED IN MAKING A WELD THAT WILL WITHSTAND STRESS UNDER VARIOUS OPERATING CONDITIONS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED THE APPROPRIATE OXY-ACETYLENE WELDING EQUIPMENT AND PIECES OF STEEL OR CAST IRON OF VARIOUS THICKNESS, CUT STEEL WELL ENOUGH THAT THE PIECE FITS ITS INTENDED PURPOSE.

2. PROVIDED THE APPROPRIATE OXY-ACETYLENE WELDING EQUIPMENT, PROPERLY CONNECT AND INSPECT THE OXY-ACETYLENE WELDING EQUIPMENT, LIGHT, ADJUST, AND TURN-OFF THE FLAME OBSERVING SAFE PROCEDURES AND CARE OF THE EQUIPMENT TO THE SATISFACTION OF THE TEACHER.

3. PROVIDED THE APPROPRIATE OXY-ACETYLENE WELDING EQUIPMENT AND PIECES OF STEEL OR CAST IRON OF VARYING THICKNESS, BRAZE (BRONZE WELD) THE METALS USING THE APPROPRIATE ROD REQUIRED FOR THE JOB.

4. PROVIDED THE APPROPRIATE OXY-ACETYLENE WELDING EQUIPMENT AND VARIOUS PIECES OF STEEL OR CAST IRON, FUSION WELD THE METALS BY EITHER USING A FILLER ROD OR NOT USING A FILLER ROD TO ACHIEVE THE STRENGTH APPROPRIATE FOR THE USE OF THE FUSED METALS.

5. PROVIDED THE APPROPRIATE OXY-ACETYLENE WELDING EQUIPMENT AND PIECES OF STEEL, HEAT AND BEND THE METAL TO FIT A SPECIFIC SITUATION.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING THE METALS TO BE WELDED WITH THE OXY-ACETYLENE WELDER

   A. IDENTIFYING METALS BY SIGHT AND TEXTURE

(1) EXAMINING THE NATURE OF THE BREAK AND THE TYPE OF BREAK
(2) COLOR OF THE GRAIN
(3) TEXTURE OF THE METAL
(4) LISTENING TO THE RING OF THE METAL

B. IDENTIFYING METALS BY USING THE SPARK TEST

C. DETERMINING HOW THE VARIOUS METALS MAY BE WELDED

2. PREPARING THE METALS FOR WELDING OR CUTTING

A. CLEANING THE METALS TO BE WELDED

(1) REMOVING EXCESSIVE DIRT AND GREASE
(2) REMOVING RUST

B. PROCEDURES TO FOLLOW IN PREPARING AND FITTING THE METALS FOR WELDING

C. DETERMINING THE KIND OF WELD OR JOINT TO BE USED FOR A SPECIFIC SITUATION

D. PROCEDURES TO FOLLOW IN "SETTING-UP" THE METALS TO BE WELDED TO CONTROL FOR EXPANSION AND CONTRACTION OF THE METAL AND MINIMIZING DISTORTION

(1) POSITIONING THE METAL
(2) SECURING THE METAL IF NECESSARY

3. SETTING UP AND TESTING THE OXY-ACETYLENE WELDING EQUIPMENT

A. PROCEDURES TO OBSERVE IN SETTING UP THE OXY-ACETYLENE WELDING EQUIPMENT

(1) SETTING UP FOR WELDING
(2) SETTING UP FOR CUTTING

B. PROCEDURES TO FOLLOW IN TESTING THE SYSTEM FOR LEAKS AND SERVICING THE SYSTEM WHEN LEAKS OCCUR

(1) TIGHTENING THE CONNECTIONS AND TESTING THE SYSTEM
(2) REPLACING ANY DEFECTIVE PARTS

C. PROCEDURES TO FOLLOW IN MAINTAINING THE OXY-ACETYLENE WELDING EQUIPMENT

(1) CLEANING THE TIPS
(2) REPLACING "O" RINGS ON TIPS AND BLOWPIPES

D. SAFETY PRECAUTIONS TO FOLLOW WHEN WORKING WITH OXY-ACETYLENE WELDING EQUIPMENT

    (1) INSPECTING THE WORK AREA FOR POTENTIAL HAZARDS
    (2) PERSONAL SAFETY PRECAUTIONS TO OBSERVE

4. OPERATING THE OXY-ACETYLENE WELDER

    A. PROCEDURES TO FOLLOW IN LIGHTING THE BLOWPIPE AND EXTINGUISHING THE FLAME

    B. ADJUSTING THE FLAME FOR WELDING OR CUTTING VARIOUS METALS AND FOR DIFFERENT PURPOSES

    C. PROCEDURES TO FOLLOW IN SHUTTING OFF THE OXY-ACETYLENE WELDING EQUIPMENT

5. USING THE OXY-ACETYLENE WELDER FOR CUTTING METAL

    A. PREPARING THE METAL TO BE CUT

    B. PROCEDURES TO FOLLOW IN STARTING AND MAKING A CUT OR BEVEL

    C. RECOGNIZING SYMPTOMS OF A POOR CUT OR BEVEL AND MAKING ADJUSTMENTS TO PREVENT SUCH SYMPTOMS FROM OCCURING

6. BENDING AND SHAPING METAL

    A. SELECTING THE TIP AND ADJUSTING THE FLAME

    B. HEATING THE METAL

    C. BENDING THE METAL TO THE DESIRED SHAPE USING APPROPRIATE TOOLS

7. USING THE OXY-ACETYLENE WELDER FOR MAKING VARIOUS WELDS IN DIFFERENT POSITIONS

    A. GENERAL PRECAUTIONS TO OBSERVE IN MAKING A "STRONG" WELD AND MINIMIZING WELD DEFECTS

    B. PRACTICES TO FOLLOW IN FUSION WELDING VARIOUS TYPES OF JOINTS IN VARIOUS POSITIONS USING MILD STEEL

    C. PRACTICES TO FOLLOW IN FUSION WELDING CAST IRON

    D. PRACTICES TO FOLLOW IN BRONZE WELDING VARIOUS TYPES OF JOINTS IN DIFFERENT POSITIONS USING MILD STEEL

    E. PRACTICES TO FOLLOW IN BRONZE WELDING CAST IRON

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS MAKE A 90° CUT AND A 45° BEVEL CUT IN 3/16" STEEL PLATE. THE STUDENTS WILL NEED TO CHECK CUTTING CHARTS TO DETERMINE THE CUTTING TIP SIZE TO BE USED AND THE PROPER SETTING FOR OXYGEN PRESSURE.

2. HAVE THE STUDENTS CONNECT THE HOSES, CONNECT THE WELDING OR CUTTING BLOWPIPE, PRACTICE LIGHTING THE BLOWPIPE, ADJUSTING THE OXY-ACETYLENE FLAME, AND EXTINGUISHING THE OXY-ACETYLENE FLAME.

3. HAVE THE STUDENTS PREPARE TWO PIECES OF 1/4" CAST IRON FOR BRAZING. HAVE THE STUDENTS BRONZE WELD A BUTT JOINT IN CAST IRON AND TEST THE WELD.

4. HAVE THE STUDENTS MAKE A BUTT WELD USING TWO PIECES OF STEEL ABOUT 1/8" THICK. AFTER THE TWO ENDS HAVE BEEN TACKED TOGETHER, HAVE THE STUDENTS USE FILLER ROD TO MAKE THE FUSION WELD.

5. HAVE THE STUDENTS BEND GIVEN PIECES OF 1/4" X 1" X 1" ANGLE IRON TO FORM A RIGHT ANGLE. THE STUDENTS WILL NEED TO REMOVE A PORTION OF THE ANGLE IRON AND HEAT THE METAL TO MAKE THE 90° ANGLE.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. THE STUDENTS SHOULD SUBMIT FOR EVALUATION A 90° CUT MADE THROUGH 1/2" STEEL PLATE 6" LONG. THE TEACHER SHOULD EVALUATE THE STUDENTS' WORK BY CONSIDERING SUCH FACTORS AS THE STRAIGHTNESS OF THE CUT, THE ANGLE OF THE CUT, AND THE AMOUNT OF SLAG OR FUSED METAL ON THE UNDERSIDE OF THE CUT.

2. DEVELOP AN OBJECTIVE EXERCISE AND A "TRUE OR FALSE" EXERCISE FOR THE STUDENTS TO COMPLETE REGARDING THE ASSEMBLY, INSPECTION, LIGHTING, AND EXTINGUISHING OF THE OXY-ACETYLENE WELDING EQUIPMENT OR FLAME. THE STUDENT SHOULD COMPLETE THE EXERCISE AT A LEVEL OF PERFORMANCE PRE-ESTABLISHED BY THE LOCAL TEACHER.

3. THE STUDENTS SHOULD SUBMIT FOR EVALUATION A BRONZE BUTT WELD USING 3/8" CAST IRON. THE TEACHER SHOULD EVALUATE THE STUDENTS' WORK ON THE BASIS OF THE DEGREE OF FUSION ON THE UNDERSIDE OF THE WELD, THE DEGREE TO WHICH THE VEE IS FILLED AND HAS A SLIGHT CROWN, THE DEGREE OF RIPPLING IN THE CROWN, AND WHETHER THE CAST IRON BREAKS OR THE WELD BREAKS WHEN TESTED.

4. THE STUDENTS SHOULD SUBMIT FOR EVALUATION A FUSION BUTT WELD USING 1/8" METAL 6" LONG. THE TEACHER SHOULD EVALUATE THE STUDENTS' WORK BY CONSIDERING SUCH FACTORS AS UNIFORM WIDTH, HEIGHT, RIPPLE, AND DEGREE OF PENETRATION ON THE UNDERSIDE OF THE WELD.

5. HAVE THE STUDENTS SUBMIT FOR EVALUATION A BRACE MADE FROM 3/16" STEEL WITH THE FOLLOWING SPECIFICATIONS: (1) 90° ANGLE, (2) 6" FROM ONE END OF THE BRACE TO THE BACK OF ADJOINING LEG, AND (3) 4 1/2" FROM ONE END OF THE BRACE TO THE BACK OF THE OTHER ADJOINING LEG.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. DIFFERENT TYPES OF METAL OF VARYING THICKNESS FOR THE STUDENTS TO WORK ON

2. A SUFFICIENT NUMBER OF OXY-ACETYLENE WELDERS

3. OXY-ACETYLENE WELDING ACCESSORIES INCLUDING GLOVES, GOGGLES, CLAMPS, PLIERS, FRICTION IGNITERS, TIP CLEANERS, WELDING TABLES, WELDING RODS, AND TIPS OF VARIOUS SIZES FOR WELDING AND CUTTING.

4. VISES, HAMMERS, AND WIRE BRUSHES

5. CHARTS SHOWING TIP SIZES TO USE AND PRESSURE SETTINGS TO USE FOR VARIOUS SITUATIONS.

F. EXAMPLES OF SUPPORTING REFERENCES

1. AGRIBUSINESS: METAL WORKING. MONTGOMERY, ALABAMA: AGRICULTURAL EDUCATION SERVICE, ALABAMA STATE DEPARTMENT OF EDUCATION. PP. 89-120.

   A STUDENT STUDY GUIDE, THIS PUBLICATION MAY BE USED AS A STUDENT WORKBOOK IN COVERING ALL AREAS OF OXY-ACETYLENE WELDING. STUDY QUESTIONS ARE PROVIDED AND ACTIVITIES SUGGESTED THAT THE STUDENT MAY COMPLETE.

2. BALL, TOM. SOURCE UNIT IN OXY-ACETYLENE WELDING. DENVER, COLORADO: DEPARTMENT OF VOCATIONAL EDUCATION, COLORADO STATE UNIVERSITY. 1970, 59 PAGES.

   BASICALLY A TEACHER'S REFERENCE, THIS PUBLICATION INCLUDES VARIOUS EXERCISES FOR STUDENTS AND A GENERAL OUTLINE OF THE STUDY AREA TO BE TAUGHT.

3. OXY-ACETYLENE WELDING AND CUTTING. VAS 3001. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1971, 28 PAGES.

   THIS PUBLICATION COVERS THE BASIC OPERATIONS OF OXY-ACETYLENE WELDING IN A CONCISE MANNER THAT STUDENTS WILL FIND RELATIVELY EASY TO UNDERSTAND. INCLUDED ARE ILLUSTRATIONS THAT EMPHASIZE IMPORTANT POINTS IN MAKING VARIOUS WELDS.

4. PHIPPS, LLOYD JAMES. FARM MECHANICS TEXT AND HANDBOOK. DANVILLE, ILLINOIS: THE INTERSTATE PRINTERS AND PUBLISHERS, INC. 1964, PP. 279-310.

   THIS REFERENCE COVERS THE BASIC OXY-ACETYLENE WELDING OPERATIONS, AND IT LISTS THE VARIOUS STEPS THAT SHOULD BE OBSERVED FOR USING THE OXY-ACETYLENE WELDER SAFELY FOR MAKING THE VARIOUS WELDS.

5. WELDING AND CUTTING MANUAL: HOW TO USE YOUR OXY-ACETYLENE OUTFIT. NEW YORK, NEW YORK: DIVISION OF UNION CARBIDE CORPORATION, LINDE COMPANY. 1949, 208 PAGES.

   WELL ILLUSTRATED, THIS PUBLICATION COVERS IN DEPTH THE VARIOUS ASPECTS OF OXY-ACETYLENE WELDING. HOWEVER, THE STUDENT WILL FIND THAT THIS IS A RELATIVELY EASY TO UNDERSTAND REFERENCE.

AGRICULTURAL EQUIPMENT BODY RECONDITIONING

UNIT CONCEPT: IN RECONDITIONING AGRICULTURAL EQUIPMENT, PARTICULAR ATTENTION MUST BE PAID TO THE CLEANING AND PREPARATION OF THE EQUIPMENT TO BE RECONDITIONED, THE PRIMING, AND THE PAINTING IF INCREASED VALUE AND LONGER LIFE IS TO BE ADDED TO THE AGRICULTURAL EQUIPMENT.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED EQUIPMENT TO BE RECONDITIONED, COMPLETELY CLEAN THE EQUIPMENT USING EITHER AIR, CHEMICALS, AND/OR STEAM BY FOLLOWING THE DIRECTIONS IN THE OPERATOR'S MANUAL FOR THE STEAM CLEANER OR OTHER EQUIPMENT.

2. PROVIDED CLEANED EQUIPMENT TO BE RECONDITIONED, SAND AND FEATHEREDGE THE EQUIPMENT TO MEET THE STANDARDS ESTABLISHED BY THE INSTRUCTOR.

3. PROVIDED EQUIPMENT READY FOR PRIMING, MASK OR PREPARE THE EQUIPMENT FOR PRIMING BY OTHER APPROPRIATE MEANS SUGGESTED BY THE INSTRUCTOR.

4. PROVIDED EQUIPMENT READY FOR PRIMING, APPLY A PRIMER COAT AND "RUB-OUT" SO THAT A PRIMER COAT IS OBTAINED THAT MEETS THE TEACHER'S APPROVAL.

5. PROVIDED EQUIPMENT READY FOR PAINTING, APPLY THE FINISHING COAT(S) USING SPRAY PAINTING EQUIPMENT AND "TOUCH-UP" THE EQUIPMENT WHEN NECESSARY SO THAT A FINISHED COAT IS OBTAINED THAT MEETS THE TEACHER'S APPROVAL.

6. PROVIDED APPROPRIATE SPRAY PAINTING EQUIPMENT, PREPARE THE EQUIPMENT FOR SPRAYING AND CLEAN AND MAINTAIN THE SPRAYING EQUIPMENT BY FOLLOWING PROCEDURES DETAILED IN THE SPRAY GUN OPERATOR'S MANUAL.

B. INSTRUCTIONAL AREAS

1. CLEANING AGRICULTURAL EQUIPMENT

    A. PRECAUTIONS AND PROCEDURES IN USING CHEMICALS FOR CLEANING VARIOUS COMPONENTS OF AGRICULTURAL EQUIPMENT

   B. PROCEDURES AND PRECAUTIONS TO FOLLOW IN USING STEAM FOR CLEANING AGRICULTURAL EQUIPMENT

   C. PRACTICES TO FOLLOW IN USING AIR TO CLEAN AGRICULTURAL EQUIPMENT

2. PREPARING CLEANED AGRICULTURAL EQUIPMENT FOR APPLYING PRIMER

   A. REMOVING DENTS AND STRAIGHTENING METAL

   B. REPLACING DEFECTIVE OR BROKEN PARTS

   C. SANDING AND FEATHEREDGING THE EQUIPMENT FOR THE PRIMER COAT

   D. MASKING THE EQUIPMENT OR USING OTHER METHODS TO PREPARE FOR APPLYING THE PRIMER COAT

3. OPERATING SPRAY PAINTING EQUIPMENT

   A. MIXING, THINNING, AND STRAINING PAINT

   B. SAFETY PRECAUTIONS THAT SHOULD BE OBSERVED IN OPERATING PAINT SPRAYING EQUIPMENT

   C. ADJUSTING THE SPRAY PAINTING GUN

   D. FACTORS TO CONSIDER IN USING THE SPRAY PAINTING GUN THAT WILL INFLUENCE A SUCCESSFUL PAINT JOB

   E. CLEANING THE SPRAY GUN

   F. CLEANING THE PRESSURE PAINT TANK

4. APPLYING THE PRIMER COAT ON AGRICULTURAL EQUIPMENT

   A. SELECTING A PRIMER PAINT

   B. APPLYING THE PRIMER COAT

5. APPLYING THE FINISH COAT

   A. SELECTING A FINISH PAINT

   B. APPLYING THE FINISH COAT

   C. TOUCHING-UP THE PAINT JOB

   D. APPLYING STENCILS AND DECALS

   E. REMOVING MASKING TAPE OR OTHER MATERIALS USED IN MASKING

6. CORRECTING A POOR PAINT APPLICATION JOB
    A. IDENTIFYING "DEFECTIVE" PAINT SPOTS
    B. DETERMINING HOW TO CORRECT FOR DEFECTIVE PAINT JOBS
    C. "RUBBING OUT" DEFECTIVE SPOTS

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USE A COMMERCIAL SOLVENT AND A STEAM CLEANER TO CLEAN THE ENGINE AND OTHER PARTS OF AGRICULTURAL EQUIPMENT IN PREPARING IT FOR REPAINTING. HAVE THE STUDENTS DISASSEMBLE AND POSITION PARTS FOR EASIEST METHOD OF SANDING AND PAINTING.

2. USING FINE SAND PAPER OR EMORY CLOTH AND WATER, HAVE THE STUDENTS FEATHEREDGE THE HOOD OF A USED FARM TRACTOR IN PREPARATION FOR REPAINTING.

3. MASK A TRACTOR FOR PAINTING USING MASKING TAPE, GREASE, OR OTHER APPROPRIATE MATERIALS AND WIPE THE EQUIPMENT WITH A "TACK RAG" DIPPED IN THIN VARNISH.

4. USING A PAPER STRAINER, CHEESECLOTH, OR OLD NYLONS, HAVE THE STUDENTS STRAIN THE PAINT BEFORE APPLYING THE PRIMER OR FINISH COAT.

5. HAVE SEVERAL STUDENTS DEMONSTRATE THE EFFECT OF HOLDING THE SPRAY GUN TOO CLOSE OR TOO FAR FROM THE METAL SURFACE TO BE SPRAYED BY USING APPROPRIATE SPRAY PAINTING EQUIPMENT AND SEVERAL METAL PANELS.

6. HAVE THE STUDENTS CLEAN THE SPRAY GUN USING THE SAME SOLVENT AS WAS USED TO THIN THE MATERIAL FOR SPRAYING. LUBRICATE ALL MOVING PARTS WITH A FEW DROPS OF OIL, AND LUBRICATE CUP THREADS BY USING VASELINE.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP "TRUE" OR "FALSE" TEST ITEMS WHICH RELATE TO THE USE OF THE STEAM CLEANER FOR CLEANING AGRICULTURAL EQUIPMENT. HAVE THE STUDENTS COMPLETE THE EXERCISE AT A LEVEL OF PERFORMANCE ESTABLISHED BY THE LOCAL TEACHER.

2. HAVE THE STUDENTS SAND AND FEATHEREDGE A PORTION OF THE EQUIPMENT WHICH THEY ARE PREPARING TO REPAINT. THESE PORTIONS COULD BE FENDERS OR A HOOD FROM A TRACTOR WHICH THE STUDENT WOULD SUBMIT TO THE TEACHER FOR FORMAL EVALUATION. THE TEACHER SHOULD EVALUATE

THE WORK SUBMITTED FOR EVALUATION CONSIDERING SUCH FACTORS AS REMOVAL OF LOOSE PAINT, REMOVAL OF RUST, AND DEGREE OF SMOOTHNESS.

3. DEVELOP AN OBJECTIVE TEST EXERCISE FOR THE STUDENTS TO COMPLETE. DESCRIBE OR LIST THE PARTS WHICH ARE TO BE MASKED ON THE EQUIPMENT FOR REPAINTING AND HAVE THE STUDENTS DESCRIBE OR LIST THE MATERIALS THEY WOULD USE TO MASK THE PARTS. EVALUATE THE STUDENT'S ANSWER BY CONSIDERING THE APPROPRIATENESS OF THE MATERIALS TO BE USED FOR MASKING.

4. PROVIDE EACH STUDENT WITH A METAL 6" X 6" PANEL WHICH HAS "RUNS" IN THE COAT OF PAINT. HAVE EACH STUDENT "RUB OUT" THE RUNS AND SUBMIT THE PANEL FOR EVALUATION. EVALUATE THE STUDEN'S WORK BY CONSIDERING THE DEGREE TO WHICH THE "RUN" HAS BEEN REMOVED AND THE SMOOTHNESS OF THE SUBMITTED EVIDENCE.

5. PRESENT A SERIES OF 6" X 6" METAL PANELS WHICH HAVE A "GOOD" OR "BAD" COAT OF PAINT APPLIED. HAVE THE STUDENTS LIST OR DESCRIBE WHAT THE PROBLEM IS IN THE COAT OF PAINT AND WHAT CAUSED THE "BAD" COAT OF PAINT.

6. HAVE THE STUDENTS LIST THE PROCEDURES THEY WOULD FOLLOW IN CLEANING THE SPRAY GUN. EVALUATE THE STUDENTS' ANSWERS AGAINST THE CRITERIA LISTED IN THE SPRAY GUN OPERATOR'S MANUAL.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. DIFFERENT TYPES OF AGRICULTURAL EQUIPMENT FOR THE STUDENTS TO WORK ON

2. COMPLETE UNIT OF SPRAY PAINTING EQUIPMENT AND BOOTH WITH VENTILATION SYSTEM

3. AIR COMPRESSOR, PARTS CLEANING TANK WITH COMMERCIAL SOLVENT, STEAM CLEANER, CLEANING BRUSHES AND PUTTY KNIFE

4. APPROPRIATE TOOLS FOR REMOVING PARTS FROM THE EQUIPMENT SUCH AS PLIERS, SCREWDRIVERS, WRENCHES, SOCKET SETS, HAMMERS, AND VARIOUS SIZES OF BODY DOLLIES

5. MASKING TAPE, PAPER, AND GREASE FOR MASKING THE EQUIPMENT

6. PAINT TO BE USED FOR THE FINISH COAT AND PRIMER COAT AND MATERIALS FOR THINNING

7. SANDPAPER, EMORY CLOTH, AND STRAINING MATERIALS SUCH AS OLD NYLONS OR CHEESECLOTH

F. EXAMPLES OF SUPPORTING REFERENCES

1. THE ABC'S OF SPRAY EQUIPMENT. THIRD EDITION. TOLEDO, OHIO: THE DE VILBISS COMPANY. 1954, 64 PAGES.

   WELL ILLUSTRATED, THIS REFERENCE IN A VERY BRIEF MANNER COVERS SOME OF THE BASIC PRINCIPLES OF SPRAY PAINTING. BRIEF SECTIONS COVER SUCH TOPICS AS CLEANING SPRAY GUNS, ADJUSTING SPRAYING EQUIPMENT, AND SPRAYING TECHNIQUES.

2. PHIPPS, LLOYD JAMES. FARM MECHANICS TEXT AND HANDBOOK. DANVILLE, ILLINOIS: THE INTERSTATE PRINTERS AND PUBLISHERS, INC. 1964, PP. 204-225.

   THIS REFERENCE COVERS THE BASIC PROPERTIES OF PAINTS AND PROCEDURES IN PREPARING PAINTS FOR APPLICATION. A BRIEF SECTION IS PRESENTED WHICH COVERS THE PAINTING OF METAL SURFACES AND PREPARING OF SURFACES FOR PAINTING.

3. SPRAY PAINTING. VAS 3015. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1963, 28 PAGES.

   THIS REFERENCE COVERS THE OPERATION OF SPRAY PAINTING EQUIPMENT AND THE TECHNIQUES THAT WILL RESULT IN A QUALITY PAINT JOB. ALSO COVERED IS A SECTION ON THE IMPROPER OPERATION OF SPRAY PAINTING EQUIPMENT AND THE REMEDIES FOR THE SYMPTOMS OF AN IMPROPER OPERATING SPRAY GUN.

TROUBLESHOOTING ENGINES

UNIT CONCEPT: WHENEVER SERVICE IS REQUIRED ON THE ENGINE DUE TO A COMPLAINT OR FAILURE, THE PERSON DOING THE REPAIR OR SERVICE WORK MUST BE ABLE TO DETERMINE THE CAUSE(S) OF THE TROUBLE IN A LOGICAL MANNER RATHER THAN BY A "HIT-OR-MISS" PROCEDURE. IF A PERSON CAN USE A LOGICAL MANNER IN DIAGNOSING THE TROUBLE, COSTLY AND TIME CONSUMING REMOVAL OR DISASSEMBLY CAN BE ELIMINATED, THE SERVICE OR REPAIR JOB WILL BE COMPLETED FASTER, COSTS WILL BE REDUCED, AND DELAYS WHICH IRRITATE THE CUSTOMER MAY BE AVOIDED.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED ENGINES THAT ARE NOT OPERATING PROPERLY, FOLLOW PROCEDURES DETAILED IN THE SERVICE MANUAL IN MAKING A "VISUAL AND EAR" INSPECTION FOR DEFECTS IN THE VARIOUS ENGINE COMPONENTS.
2. PROVIDED ENGINES THAT ARE NOT OPERATING PROPERLY, USE THE TESTING EQUIPMENT TO DIAGNOSE ENGINE TROUBLES BY FOLLOWING DIRECTIONS IN THE SERVICE MANUAL AND/OR IN THE OPERATOR'S MANUAL FOR THE TEST EQUIPMENT BEING USED.

B. INSTRUCTIONAL AREAS

1. PROCEDURES FOR TROUBLESHOOTING ENGINES
    - A. KNOWING THE SYSTEM
    - B. INSPECTING THE ENGINE
    - C. OPERATING THE ENGINE
    - D. LISTING PROBABLE CAUSES
    - E. REACHING A CONCLUSION
    - F. TESTING YOUR CONCLUSION
2. PROPER CARE AND MAINTENANCE OF TESTING EQUIPMENT
    - A. USING THE EQUIPMENT
    - B. STORING AND CARING FOR THE TEST EQUIPMENT

3. IDENTIFYING THE SYMPTOMS AND MAKING A PRELIMINARY DIAGNOSIS BY VISUAL AND "EAR" INSPECTION, USING TEST EQUIPMENT AND FOLLOWING PROCEDURES IN THE SERVICE MANUAL.

   A. ENGINE WILL NOT START OR IS HARD TO START

      (1) CHECKING THE ELECTRICAL STARTING SYSTEM
      (2) CHECKING FOR CORRECT FUEL
      (3) CHECKING THE COMPRESSION

   B. LACK OF POWER

      (1) CHECKING THE FUEL SYSTEM
      (2) CHECKING FOR SLIPPAGE IN THE TRACTION CLUTCH
      (3) CHECKING THE OPERATING TEMPERATURE OF THE ENGINE
      (4) USING VACUUM GAUGE TO MAKE MANIFOLD DEPRESSION TEST
      (5) CHECKING THE AIR INTAKE AND EXHAUST SYSTEM
      (6) CHECKING ENGINE RPM WITH TACHOMETER
      (7) CHECKING COMPRESSION
      (8) CHECKING FOR MISFIRING
      (9) CHECKING CRANKCASE OIL

   C. SMOKE FROM EXHAUST SYSTEM (ESPECIALLY ON DIESEL ENGINES)

      (1) CHECKING OPERATING TEMPERATURE
      (2) CHECKING FUEL
      (3) CHECKING THE AIR INTAKE AND EXHAUST SYSTEM
      (4) CHECKING THE COMBUSTION SYSTEM AND COMPRESSION
      (5) CHECKING THE FUEL INJECTION SYSTEM ON DIESEL ENGINE AND THE CARBURETOR
      (6) CHECKING THE CRANKCASE OIL

   D. EXCESSIVE FUEL CONSUMPTION

      (1) CHECKING THE SMOKE FROM THE EXHAUST
      (2) CHECKING THE FUEL
      (3) CHECKING FOR INTERNAL AND EXTERNAL FUEL LEAKS

   E. EXCESSIVE OIL CONSUMPTION

      (1) CHECKING THE CRANKCASE OIL
      (2) CHECKING EXHAUST SMOKE FOR COLOR INDICATING OIL CONSUMPTION
      (3) CHEKCING THE CRANKCASE BREATHER
      (4) CHECKING FOR EXTERNAL LEAKAGE

   F. EXCESSIVE ENGINE NOISE, KNOCK, AND VIBRATION

      (1) CHECKING TO SEE IF THE NOISE RESPONDS TO CHANGES IN RPM

(2) CHECKING FOR ENGINE KNOCK AND VIBRATION UNDER "COLD" AND "HOT" OPERATING CONDITIONS

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS VISUALLY INSPECT THE ENGINE FOR ANY SYMPTOMS WHICH MAY INDICATE PROBLEMS WITH THE INTERNAL COMBUSTION ENGINE. THE STUDENTS SHOULD BE LOOKING FOR SUCH DEFECTS AS WATER LEAKS, OIL LEAKS, OR LOOSE BELTS AND FRAYED BELTS.

2. HAVE THE STUDENTS COMPLETE A MANIFOLD VACUUM TEST ON AN ENGINE. THE STUDENTS WILL NEED TO BRING THE ENGINE UP TO OPERATING TEMPERATURE, INSTALL THE VACUUM GAUGE, AND OPERATE THE ENGINE AT VARIOUS SPEEDS TO CHECK THE VACUUM GAUGE READING. THE STUDENTS WILL NEED TO INTERPRET THE VACUUM GAUGE READING ACCORDING TO DIRECTIONS SPECIFIED IN THE SERVICE MANUAL.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. USING ENGINES THE STUDENTS WILL WORK ON, HAVE THE STUDENTS TROUBLESHOOT THE ENGINE BY VISUAL AND "EAR" INSPECTION FOR DEFECTS. THE STUDENTS SHOULD LIST THE SYMPTOMS THEY OBSERVED.

2. USING ENGINES ON WHICH THE STUDENTS WILL WORK, HAVE THE STUDENTS CHECK THE TIMING ON AN ENGINE WITH A TIMING LIGHT. THE STUDENTS SHOULD DETERMINE WHETHER THE TIMING IS CORRECT OR INCORRECT ACCORDING TO THE SPECIFICATIONS IN THE SERVICE MANUAL.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. ENGINES FOR THE STUDENTS TO WORK ON

2. SPECIALIZED TEST EQUIPMENT SUCH AS TIMING LIGHTS, VACUUM GAUGE, DYNAMOMETER, COMPRESSION GAUGE, THERMOSTAT TESTING INSTRUMENT, HYDROMETER, METERS FOR CHECKING THE ELECTRICAL SYSTEM, AND TACHOMETER

3. APPROPRIATE SMALL HAND TOOLS SUCH AS WRENCHES, PLIERS, SCREWDRIVERS, AND SOCKET SET

4. TROUBLESHOOTING CHARTS

5. SERVICE MANUALS

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATION. 1972, PP. 11-1 - 12-1.

   A GENERAL OUTLINE IS PRESENTED WHICH COVERS THE BASIC PROCEDURES OF TROUBLESHOOTING THE INTERNAL COMBUSTION ENGINE. TROUBLESHOOTING CHARTS ARE PROVIDED FOR AIDING THE STUDENT IN DIAGNOSING THE CAUSE(S) OF THE OBSERVED SYMPTOM(S).

2. SERVICE MANUALS FOR THE ENGINES BEING WORKED ON.

   THE SERVICE MANUALS USUALLY PROVIDE A SECTION ON PROCEDURES FOR TROUBLESHOOTING THE ENGINE AND TROUBLESHOOTING CHARTS WHICH THE STUDENTS WILL FIND HELPFUL IN DIAGNOSING THE NATURE OF THE MALFUNCTIONS.

THE COMPRESSION SYSTEM OF SINGLE CYLINDER ENGINES

UNIT CONCEPT: THE BURNING OF THE AIR-FUEL MIXTURE IN THE COMPRESSION OR COMBUSTION CHAMBER RESULTS IN VARIOUS PARTS OPERATING UNDER HIGH TEMPERATURES AT VARIOUS SPEEDS. THE OPERATION UNDER SUCH CONDITIONS MAY RE[illegible] WEAR TO SUCH PARTS AS THE RINGS AND [illegible]H COULD RESULT IN REDUCED ENGINE PO[illegible] AND [illegible]REASED GAS AND/OR OIL CONSUMPTION. [illegible] ABILITY TO DIAGNOSE SUCH PROBLEMS IN THE COMPR[illegible] SYSTEM AND CORRECT THE PROBLEMS WILL RESULT IN WORK BEING PERFORMED QUICKER AND AT A MINIMAL COST.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PRESENTED WITH VARIOUS PARTS OF THE COMPRESSION SYSTEM IN A SMALL GASOLINE ENGINE, CORRECTLY IDENTIFY ALL THE PARTS AND DESCRIBE THE FUNCTION OF THE PART IN THE COMPRESSION SYSTEM TO THE SATISFACTION OF THE TEACHER.
2. WHEN GIVEN A SMALL GASOLINE ENGINE WITH OPERATING SYMPTOMS THAT MAY BE CAUSED BY DEFECTS IN THE COMPRESSION SYSTEM, DIAGNOSE THE NATURE OF THE MALFUNCTION(S) FOLLOWING APPROVED TROUBLESHOOTING PROCEDURES.
3. WHEN PROVIDED WITH A SMALL GASOLINE ENGINE WITH DEFECTS IN THE COMPRESSION SYSTEM, DISASSEMBLE THE ENGINE, REPAIR AND/OR SERVICE, REASSEMBLE, AND ADJUST THE PARTS NEEDING REPAIR OR SERVICE ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

B. INSTRUCTIONAL AREAS

1. DETERMINING THE PURPOSE OF THE COMPRESSION SYSTEM AND PARTS WITHIN THE COMPRESSION SYSTEM
    - A. DETERMINING THE FUNCTIONS OF THE VARIOUS PARTS IN THE COMPRESSION SYSTEM
    - B. PRINCIPLES OF COMPRESSION AND PRINCIPLES OF COMBUSTION IN THE INTERNAL COMBUSTION ENGINE

(1) DETERMINING WHY SUCH TERMS AS COMPRESSION RATIO, PISTON DISPLACEMENT, TCD, AND BDC ARE IMPORTANT TO A PERSON WORKING ON THE COMPRESSION SYSTEM.

2. IDENTIFYING DEFECTS OR SYMPTOMS ON SMALL GASOLINE ENGINES THAT MAY INDICATE DEFECTS IN VARIOUS PARTS FOUND WITHIN THE COMPRESSION SYSTEM

   A. PROCEDURES FOR TROUBLESHOOTING THE COMPRESSION SYSTEM ON SMALL GASOLINE ENGINES

   B. INSPECTING FOR DEFECTS IN VARIOUS PARTS OF THE COMPRESSION SYSTEM

      (1) IDENTIFYING DEFECTS IN THE CYLINDER OR HEAD

         (A) INSPECTING FOR A DAMAGED HEAD GASKET OR A WARPED HEAD
         (B) INSPECTING THE CYLINDER WALLS FOR SCORING, RIDGES, AND MEASURING THE CYLINDER FOR TAPERED WALLS OR OUT-OF-ROUND

      (2) IDENTIFYING DEFECTS IN THE PISTON AND RINGS

         (A) VISUALLY INSPECTING THE RINGS FOR SCORING, DEPOSITS, ROUNDED EDGES AND MEASURING RING-END GAP AND RING LAND SIDE CLEARANCE
         (B) VISUALLY INSPECTING THE PISTON FOR SCORING, SCUFFING, DEPOSITS, AND MEASURING SKIRT CLEARANCE AND RING GROOVE WEAR

      (3) IDENTIFYING DEFECTS IN THE CONNECTING ROD AND CRANKSHAFT

         (A) VISUALLY INSPECTING THE CRANKSHAFT JOURNALS AND SLEEVE BUSHINGS OR BEARINGS FOR SIGNS OF ABRASIVE WEAR AND MEASURING THE JOURNAL-BUSHING CLEARANCE AND CRANKSHAFT ENDPLAY
         (B) VISUALLY CHECKING THE CONNECTING ROD AND BEARING CAP FOR SIGNS OF ABRASIVE WEAR, THE WRIST PIN FOR "SLAP," AND MEASURING THE ROD BEARING CLEARANCE

      (4) IDENTIFYING DEFECTS IN THE VALVE ASSEMBLY

         (A) VISUALLY INSPECTING THE VALVES ON A FOUR STROKE CYCLE ENGINE FOR BURNED FACES, DISHED NECKS, WARPED VALVE HEADS, NARROW MARGINS, WEAK VALVE SPRINGS, AND MEASURING VALVE TAPPET CLEARANCE AND VALVE STEM-GUIDE CLEARANCE

(B) VISUALLY INSPECTING THE REED ASSEMBLY ON TWO STROKE CYCLE ENGINES

3. CORRECTING THE PROBLEMS IN THE COMPRESSION SYSTEM

   A. REPAIRING OR SERVICING THE CYLINDER AND HEAD

      (1) CLEANING DEPOSITS FROM THE HEAD, RESTORING SPARK PLUG THREADS, REPLACING THE HEAD GASKET, AND TORQUING THE HEAD
      (2) REMOVING THE CYLINDER WALL RIDGES AND DEGLAZING THE CYLINDER WALLS

   B. SERVICING THE PISTON AND PISTON RINGS

      (1) INSTALLING PISTON RINGS ON THE PISTON
      (2) INSTALLING THE PISTON AND RING ASSEMBLY IN THE ENGINE BLOCK

   C. REPAIRING AND SERVICING THE CONNECTING ROD AND CRANKSHAFT

      (1) INSTALLING THE WRIST PIN AND CONNECTING ROD ON THE PISTON
      (2) REPLACING AND REAMING SLEEVE BUSHINGS FOR THE CRANKSHAFT JOURNALS
      (3) INSTALLING THE CRANKSHAFT AND TORQUING THE BEARING CAP

   D. REPAIRING OR SERVICING THE VALVE ASSEMBLY

      (1) REPLACING OR REFACING THE VALVE SEAT IN THE ENGINE BLOCK OF A FOUR STROKE CYCLE ENGINE
      (2) LAPPING THE INTAKE AND EXHAUST VALVES ON A FOUR STROKE CYCLE ENGINE
      (3) ADJUSTING THE VALVE TAPPET CLEARANCE ON A FOUR STROKE CYCLE ENGINE
      (4) CLEANING AND REPLACING THE REEDS ON A TWO STROKE CYCLE ENGINE

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING A PAPER EXERCISE WHICH HAS ILLUSTRATIONS OF THE VALVE ASSEMBLY IN A FOUR STROKE CYCLE AND A TWO STROKE CYCLE ENGINE BLOCK AND A CROSS SECTION SHOWING THE PISTON, ROD, AND CRANKSHAFT ASSEMBLY IN THE FOUR STROKE ENGINE, HAVE THE STUDENTS IDENTIFY THE PROPER NAME OF THE PARTS THE TEACHER HAS INDICATED AND WRITE THE FUNCTION OR PURPOSE OF THE PART IN THE SPACE PROVIDED.

2. HAVE SEVERAL ENGINES PREPARED WITH PROBLEMS IN THE COMPRESSION SYSTEM SUCH AS A "BLOWN" HEAD GASKET, BROKEN VALVE SPRING, BROKEN PISTON RINGS, OR STICKING REED VALVES ON A TWO CYCLE OR STICKING INTAKE VALVE ON A FOUR CYCLE ENGINE. WITH THE STUDENTS WORKING IN TEAMS OF TWO IN THE SCHOOL SHOP, HAVE THEM DIAGNOSE WHAT THE PROBLEM(S) MAY BE IN THE COMPRESSION SYSTEM THAT MAY BE CAUSING OR CONTRIBUTING TO THE SYMPTOMS OBSERVED IN THE ENGINE.

3. A. USING PLASTIGAGE AND THE CRANKSHAFT, ROD, AND BEARING CAP ASSEMBLED IN A SMALL GASOLINE ENGINE, HAVE THE STUDENTS MEASURE AND RECORD THE BEARING CAP-CRANKPIN CLEARANCE AND DETERMINE WHAT PROCEDURES TO FOLLOW TO CORRECT THE CLEARANCE IF IT DOES NOT FALL WITHIN THE MANUFACTURER'S TOLERANCE RANGE.

   B. USING THE CYLINDER BLOCK FROM THE ENGINE THE STUDENTS ARE WORKING ON AND A RIDGE REAMER AND A HONING TOOL, HAVE THE STUDENTS REMOVE THE RIDGE IF IT IS DEEMED NECESSARY AND DEGLAZE THE CYLINDER WALL SUCH THAT A CROSS HATCHED PATTERN IS EVIDENT.

   C. USING A FOUR STROKE CYCLE ENGINE, HAVE THE STUDENTS CHECK THE VALVE TAPPET CLEARANCE ON THE INTAKE AND EXHAUST VALVES WITH A FEELER GAUGE AND USING AN ELECTRIC GRINDER OR HAND FILE REMOVE MATERIAL FROM THE VALVE STEM WHEN THERE IS INSUFFICIENT TAPPET CLEARANCE SUCH THAT A TAPPET CLEARANCE READING IS CONSISTENT WITH THE MANUFACTURER'S SPECIFICATIONS.

   D. USING THE ENGINE BLOCK FROM EITHER TWO STROKE CYCLE ENGINES OR FOUR STROKE CYCLE ENGINES AND THE OLD PISTON RINGS FROM THE ENGINE, HAVE THE STUDENTS CHECK THE RING-GAP AND DETERMINE IF THE MEASUREMENT FOUND IS GREATER OR LESS THAN THE REJECTION SPECIFICATIONS.

   E. USING THE ENGINE BLOCK, THE HEAD GASKET, AND THE ENGINE HEAD, HAVE THE STUDENTS TORQUE THE HEAD ACCORDING TO THE ENGINE SPECIFICATIONS FOLLOWING THE PROPER TORQUING SEQUENCE.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. A. USING AN EXHIBIT OF PARTS FROM THE COMPRESSION SYSTEM, HAVE THE STUDENTS COMPLETE THE FOLLOWING TWO ASPECTS OF A PAPER AND PENCIL TEST. FIRST, FROM A LIST PROVIDED BY THE TEACHER SELECT THE CORRECT NAME OF THE PART. SECOND, IN A SERIES OF SHORT COMPLETION STATEMENTS WHICH DESCRIBE THE FUNCTION(S) OF VARIOUS PARTS, HAVE THE STUDENTS WRITE IN THE NAME OF THE PART THAT PERFORMS THE INDICATED FUNCTION.

B. USING THE CROSS SECTION OF SEVEN FOUR-STROKE CYCLE ENGINE BLOCKS AND THREE TWO-STROKE CYCLE ENGINE BLOCKS WITH THE PISTON AND VALVE ASSEMBLIES INSTALLED AND ARROWS USED TO INDICATE THE DIRECTION OF PISTON TRAVEL, HAVE THE STUDENTS WRITE AT THE BOTTOM OF EACH SKETCH THE NAME OF THE STROKE(S) WHICH THE ILLUSTRATION REPRESENTS AND WHETHER THE ILLUSTRATION REPRESENTS A FOUR STROKE CYCLE OR A TWO STROKE CYCLE ENGINE.

2. FROM A LIST OF ENGINE SYMPTOMS, SOME OF WHICH MAY BE INDICATIVE OF MALFUNCTIONS IN THE COMPRESSION SYSTEM, HAVE THE STUDENTS IDENTIFY THOSE ENGINE SYMPTOMS THAT ARE MOST LIKELY TO BE CAUSED BY DEFECTS IN THE COMPRESSION SYSTEM.

3. PROVIDE THE STUDENTS WITH A SMALL GASOLINE ENGINE THAT NEEDS THE VALVE TAPPETS ADJUSTED AND A SERVICE MANUAL. HAVE THE STUDENTS ADJUST THE VALVE TAPPET CLEARANCE AND EVALUATE THEM ON THE BASIS OF THE PROCEDURES THEY USE TO SET THE TAPPET CLEARANCE AND THE ACCURACY OF THE ADJUSTMENT IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. CUT AWAY MODEL OF A TWO STROKE CYCLE ENGINE AND A FOUR STROKE CYCLE ENGINE
2. SMALL GASOLINE ENGINES FOR STUDENTS TO WORK ON
3. EXAMPLES OF DAMAGED PARTS THAT MAY BE FOUND IN THE COMPRESSION SYSTEM SUCH AS WORN PISTON RINGS, SCORED PISTONS, BURNED VALVES, WARPED VALVES, BURRED OR SCORED SLEEVE BUSHINGS, DAMAGED BEARING CAPS, OR WARPED CYLINDER HEADS
4. APPROPRIATE SMALL HAND TOOLS INCLUDING PISTON RING EXPANDER, PISTON RING COMPRESSOR, VALVE SPRING COMPRESSOR, MICROMETERS, FEELER GAUGE, TORQUE WRENCH, TELESCOPING GAUGE, CYLINDER RIDGE REAMER, VALVE SEAT GRINDER, OR LAPPING TOOL, LAPPING COMPOUND, REAMER SET

F. EXAMPLES OF SUPPORTING REFERENCES

1. BRIGGS AND STRATTON REPAIR INSTRUCTIONS III. MILWAUKEE, WISCONSIN: BRIGGS AND STRATTON CORPORATION. 122 PAGES.

2. ENGINE THEORY STUDENT ACTIVITY MANUAL. ST. PAUL, MINNESOTA: TECHNICAL SYSTEMS, INC. 1972, PP. 1-1 - 4-6.

   DEVELOPED AS A STUDENT STUDY GUIDE OR WORK BOOK, THIS PUBLICATION PROVIDES SOME EXCELLENT CLASSROOM EXERCISES FOR DISCUSSING THE COMPRESSION SYSTEM. INCLUDED ARE SUCH EXERCISES AS CALCULATING PISTON DISPLACEMENT, COMPRESSION RATIO, AND DEVELOPING A VALVE TIMING CHART.

3. SMALL GASOLINE ENGINES: OPERATION AND MAINTENANCE. ST. PAUL, MINNESOTA: HOBAR PUBLICATIONS. 1973, PP. 1-28.

   THIS REFERENCE INCLUDES A VERY EXCELLENT PRESENTATION OF THE TECHNICAL MATERIAL IN EASY TO UNDERSTAND TERMS AND INCLUDES A LIST OF TERM DEFINITIONS AND A SERIES OF CLASSROOM AND LABORATORY ACTIVITIES. ILLUSTRATIONS ARE PROVIDED WHICH HELP TO DEMONSTRATE THE PRACTICAL APPLICATION OF VARIOUS STUDENT ACTIVITIES.

4. SMALL ENGINES - PRINCIPLES OF OPERATION, TROUBLESHOOTING, AND TUNE-UP. VAS 3014. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1962, 16 PAGES.

   INCLUDED IN THIS REFERENCE IS A VERY BRIEF YET COMPREHENSIVE PRESENTATION OF THE TWO CYCLE AND FOUR CYCLE ENGINE AND THE BASIC PRINCIPLES OF OPERATION. STUDENTS WILL FIND THIS REFERENCE TO BE EASY TO UNDERSTAND.

5. SMALL ENGINES SERVICE MANUAL. KANSAS CITY, MISSOURI: TECHNICAL PUBLICATIONS DIVISION, INTERTEC PUBLISHING CORPORATION. 1969, 328 PAGES.

   THIS PUBLICATION COVERS THE VARIOUS ASSEMBLIES FOUND IN THE COMPRESSION SYSTEM OF BOTH THE FOUR STROKE CYCLE AND THE TWO STROKE CYCLE ENGINES. WELL ILLUSTRATED, THIS REFERENCE IN MANY CASES, PROVIDES A GENERAL PROCEDURE LIST TO FOLLOW IN REPAIRING AND SERVICING THE VARIOUS ASSEMBLIES IN THE COMPRESSION SYSTEM.

THE IGNITION SYSTEM OF SINGLE CYLINDER ENGINES

UNIT CONCEPT: THE ABILITY TO REPAIR AND/OR SERVICE THE VARIOUS COMPONENTS OF THE IGNITION SYSTEM IS ESSENTIAL FOR PROVIDING A SPARK OF THE PROPER INTENSITY AT THE PROPER TIME TO IGNITE THE COMPRESSED CHEMICAL MIXTURE OF GASOLINE AND AIR. THE ABILITY TO DIAGNOSE AND MAINTAIN IGNITION SYSTEMS IN OPTIMUM WORKING ORDER WILL RESULT IN MINIMIZING STARTING PROBLEMS, RUNNING IRREGULARLY, BACKFIRING, AND OVERHEATING.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PRESENTED WITH VARIOUS COMPONENTS OF THE IGNITION SYSTEM OR SPECIFIC PARTS OF THE IGNITION COMPONENTS, CORRECTLY IDENTIFY ALL THE COMPONENTS OR PARTS AND DESCRIBE THE FUNCTION OF THE COMPONENT OR PART IN THE IGNITION SYSTEM TO THE SATISFACTION OF THE TEACHER.

2. WHEN PROVIDED WITH A SMALL GASOLINE ENGINE WITH OPERATING SYMPTOMS THAT MAY BE CAUSED BY DEFECTS IN THE IGNITION SYSTEM, DIAGNOSE THE NATURE OF THE MALFUNCTION(S) FOLLOWING APPROVED TROUBLESHOOTING PROCEDURES.

3. WHEN PROVIDED WITH A SMALL GASOLINE ENGINE WITH DEFECTS IN THE IGNITION SYSTEM, DISASSEMBLE, REPAIR AND/OR SERVICE, REASSEMBLE, AND ADJUST THE COMPONENTS OF THE IGNITION SYSTEM ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

B. INSTRUCTIONAL AREAS

1. DETERMINING THE FUNCTIONS OF THE IGNITION SYSTEM COMPONENTS

   A. DETERMINING THE FUNCTIONS OF THE VARIOUS COMPONENTS OF THE VARIOUS TYPES OF IGNITION SYSTEMS

      (1) COMPONENTS OF THE PRIMARY CIRCUIT
      (2) COMPONENTS OF THE SECONDARY CIRCUIT

   B. PRINCIPLES OF IGNITION IN TWO STROKE CYCLE AND FOUR STROKE CYCLE GASOLINE ENGINES

2. IDENTIFYING DEFECTS OR SYMPTOMS ON SMALL GASOLINE ENGINES THAT MAY INDICATE DEFECTS IN VARIOUS COMPONENTS OF THE IGNITION SYSTEM

   A. PROCEDURES FOR TROUBLESHOOTING THE IGNITION SYSTEM ON SMALL GASOLINE ENGINES

   B. INSPECTING THE IGNITION SYSTEM FOR DEFECTS IN THE IGNITION SYSTEM SUCH AS:

      (1) INSPECTING THE SYSTEM FOR LOOSE CONNECTIONS, WRONG CONNECTIONS, OR WIRES IN POOR PHYSICAL CONDITION
      (2) CHECKING THE CONDITION OF THE SPARK PLUG AND MEASURING THE SPARK PLUG GAP
      (3) CHECKING THE CONDITION OF THE FLYWHEEL KEY, MEASURING THE ARMATURE AIR GAP, OR CHECKING THE CONDITION OF THE ARMATURE SURFACES
      (4) INSPECTING THE CONDITION OF THE BREAKER POINTS, THE BREAKER CAM OR PUSH ROD, AND MEASURING THE POINT GAP SETTING
      (5) CHECKING THE IGNITION TIMING
      (6) CHECKING THE CONDENSOR AND COIL WITH A TESTER

3. CORRECTING THE PROBLEMS IN THE IGNITION SYSTEM

   A. PROCEDURES TO FOLLOW IN SERVICING OR REPAIRING THE SPARK PLUG AND SPARK PLUG WIRE

      (1) DETERMINING THE APPROPRIATE SPARK PLUG TO INSTALL FOR A GIVEN ENGINE AND INSTALLING THE SPARK PLUG
      (2) ADJUSTING SPARK PLUG GAP
      (3) PROCEDURES TO FOLLOW IN REPLACING THE SPARK PLUG WIRE OR REPLACING THE METAL CONNECTOR

   B. PROCEDURES TO FOLLOW IN REPLACING THE FLYWHEEL KEY OR ADJUSTING ARMATURE AIR GAP

      (1) INSTALLING THE PROPER FLYWHEEL KEY
      (2) ADJUSTING THE ARMATURE AIR GAP

   C. PROCEDURES FOR REMOVING, INSTALLING, AND ADJUSTING THE BREAKER POINTS AND CONDENSOR ASSEMBLY

      (1) FOLLOWING SPECIAL PRECAUTIONS THAT MUST BE OBSERVED WHEN REMOVING THE POINT ASSEMBLY FROM THE ENGINE ON CERTAIN MODELS OF ENGINES
      (2) PROCEDURES TO FOLLOW FOR INSTALLING THE POINT ASSEMBLY

(3) ADJUSTING THE BREAKER POINT GAP AND VISUALLY INSPECTING THE CONTACT BETWEEN THE BREAKER POINT SURFACES

D. PROCEDURES TO FOLLOW IN TIMING THE IGNITION SYSTEM

(1) TIMING THE MAGNETO TO THE ENGINE BY MOVING THE STATOR PLATE
(2) TIMING THE BREAKER POINTS TO THE MAGNETO BY USING A TIMING LIGHT WHEN SUCH A TIMING PROCEDURE IS DESIRED

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. A. USING A PAPER SKETCH WHICH SHOWS A CROSS SECTION OF THE COMPONENTS OF THE IGNITION SYSTEM, HAVE EACH STUDENT CHART THE FLOW OF ELECTRICAL CURRENT IN THE PRIMARY CIRCUIT BY USING A BLUE PENCIL AND THE FLOW OF ELECTRICAL CURRENT [illegible] THE SECONDARY CIRCUIT BY USING A RED PENCIL.

B. USING A PAPER SKETCH OF THE MAGNETO IGNITION SYSTEM AND A SERIES OF PREPARED STUDY QUESTIONS, HAVE THE STUDENTS LABEL THE PARTS OF THE MAGNETO IGNITION SYSTEM, DESCRIBE THE FUNCTION OF THE COMPONENTS OF THE MAGNETO IGNITION SYSTEM, AND DESCRIBE THE PARTS OF THE PRIMARY AND SECONDARY CIRCUITS.

2. HAVE SEVERAL ENGINES PREPARED WITH IGNITION SYSTEM PROBLEMS. WITH THE STUDENTS WORKING IN TEAMS OF TWO IN THE SCHOOL SHOP, HAVE THEM DIAGNOSE WHAT THE PROBLEM(S) MAY BE IN THE IGNITION SYSTEM THAT MAY BE CAUSING OR CONTRIBUTING TO THE SYMPTOMS THAT ARE OBSERVED WHEN THE ENGINE IS RUNNING OR WHEN IT WILL NOT RUN.

3. A. USING A FLAT FEELER GAUGE AND ENGINES WITH THE ARMATURE AIR-GAP CLEARANCE ADJUSTED AT VARIOUS DIMENSIONS, HAVE THE TEAMS OF STUDENTS DETERMINE WHAT THE CURRENT AIR-GAP SETTING IS ON THEIR ENGINE, FIND WHAT THE MANUFACTURER'S RECOMMENDED SETTING IS, AND THEN ADJUST THE ARMATURE AIR-GAP CLEARANCE TO THE RECOMMENDED SPECIFICATIONS.

B. USING A FEELER GAUGE AND APPROPRIATE SMALL HAND TOOLS SUCH AS SCREWDRIVERS AND A 1/4" DRIVE SOCKET SET WHEN NEEDED, HAVE THE TEAMS OF STUDENTS INSPECT THE CONDITION OF THE BREAKER POINT CONTACT SURFACES, REMOVE THE BREAKER POINT ASSEMBLY, INSTALL A NEW BREAKER POINT ASSEMBLY, AND ADJUST THE BREAKER POINT GAP TO THE MANUFACTURER'S SPECIFICATIONS.

C. USING A 13/16" SPARK PLUG SOCKET, A SPARK PLUG GAUGE, WIRE STRIPPERS, AND A CRIMPER, HAVE THE STUDENTS ADJUST THE SPARK PLUG GAP TO THE MANUFACTURER'S SPECIFICATIONS, INSTALL THE SPARK PLUG, CUT A SPARK PLUG LEAD WIRE, AND CONNECT THE LEAD WIRE TO THE COIL.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A LIST OF MATCHING ITEMS, ONE COLUMN BEING COMPONENTS OR PARTS OF THE IGNITION SYSTEM, AND ANOTHER COLUMN BEING FUNCTIONS OR PURPOSES OF THE PARTS AND COMPONENTS, AND HAVE THE STUDENTS COMPLETE THE MATCHING EXERCISE.

2. FROM A LIST OF ENGINE SYMPTOMS, SOME OF WHICH MAY BE INDICATIVE OF MALFUNCTIONS IN THE IGNITION SYSTEM, HAVE THE STUDENTS IDENTIFY THOSE ENGINE SYMPTOMS THAT ARE MOST LIKELY TO BE CAUSED BY DEFECTS IN THE IGNITION SYSTEM ON SINGLE CYLINDER ENGINES.

3. PROVIDE THE STUDENT WITH SPECIFIC INFORMATION REGARDING MODEL NUMBER, TYPE OF ENGINE, AND A SERVICE MANUAL AND HAVE THE STUDENT DETERMINE THE PROPER BREAKER POINT SETTING FOR THE ENGINE AND HAVE HIM ADJUST THE BREAKER POINT SETTING WITH A TOLERANCE OF ± .001".

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. VARIOUS TYPES OF IGNITION SYSTEMS USED ON SMALL GASOLINE ENGINES

2. VARIOUS TYPES OF SPARK PLUGS

3. VARIOUS TYPES OF BREAKER POINT ASSEMBLIES USED ON SMALL GASOLINE ENGINES

4. APPROPRIATE TOOLS FOR WORKING ON THE IGNITION SYSTEM SUCH AS A 1/4" DRIVE OR 3/8" DRIVE SOCKET SET, FLYWHEEL PULLER, OPEN END OR BOX END WRENCHES, SCREWDRIVERS, NEEDLE NOSE PLIERS, FEELER GAUGE, SPARK PLUG GAUGE, COIL TESTER, TIMING LIGHT (IF DESIRED) FLYWHEEL HOLDER, WIRE STRIPPERS, AND CRIMPER.

5. SPARK PLUG LEAD WIRE AND METAL CONNECTORS

F. EXAMPLES OF SUPPORTING REFERENCES

1. GENERAL THEORIES OF OPERATION: COMPRESSION, CARBURETION, AND IGNITION. BRIGGS AND STRATTON CORPORATION. PP. 15-18.

   THE STUDENT WILL FIND THIS TO BE A VERY SIMPLE AND EASY TO UNDERSTAND REFERENCE. INCLUDED IS A VERY EASY TO UNDERSTAND DISCUSSION AND ANALOGY OF THE PRIMARY AND SECONDARY CIRCUIT.

2. SMALL ENGINES: CARE - OPERATION - MAINTENANCE AND REPAIR, VOLUME II. ATHENS, GEORGIA: AMERICAN ASSOCIATION FOR AGRICULTURAL ENGINEERING AND VOCATIONAL AGRICULTURE. 1968, PP. 45-76.

   INCLUDED IN THIS REFERENCE ARE PROCEDURES FOR CHECKING, REPAIRING AND ADJUSTING VARIOUS COMPONENTS OF THE ELECTRICAL SYSTEM. TEACHERS WILL FIND THE COLORED ILLUSTRATIONS USEFUL FOR MAKING TRANSPARENCIES.

3. SMALL GASOLINE ENGINES: OPERATION AND MAINTENANCE. ST. PAUL, MINNESOTA: HOBAR PUBLICATIONS. 1973, PP. 29-43.

   THIS REFERENCE PRESENTS IN DETAIL THE VARIOUS FUNCTIONS OF THE COMPONENTS OF THE ELECTRICAL SYSTEM. THE TEACHER WILL FIND THAT THE CONTENT PROVIDES AN EXCELLENT BACKGROUND FOR HIM TO PREPARE TEACHING PLANS. CLASSROOM EXERCISES AND LABORATORY EXERCISES ARE PROVIDED.

4. SMALL ENGINES - REPAIR AND OVERHAUL. VAS 3019. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1965, 20 PAGES.

   AS PART OF ITS CONTENT, THE PUBLICATION INCLUDES A VERY BRIEF YET COMPREHENSIVE APPROACH TO SERVICING THE IGNITION SYSTEM. THE STUDENT SHOULD FIND THIS A VERY EASY TO FOLLOW AND UNDERSTANDABLE PRESENTATION OF THE ELECTRICAL SYSTEM. INCLUDED IS AN EXAMPLE OF A COIL AND IGNITION CIRCUIT TESTER THAT CAN BE CONSTRUCTED IN THE SHOP IN A MATTER OF MINUTES.

THE CARBURETION SYSTEM OF SINGLE CYLINDER ENGINES

UNIT CONCEPT: PROVIDING THE PROPER FUEL-AIR MIXTURE AT VARIOUS ENGINE SPEEDS BY THE CARBURETOR IS A PREREQUISITE TO EFFICIENT FUEL CONSUMPTION AND MAXIMUM POWER PRODUCTION. THE ABILITY TO DIAGNOSE ENGINE PROBLEMS DUE TO MALFUNCTIONS IN THE CARBURETION SYSTEM AND TO CORRECT THESE MALFUNCTIONS CAN SAVE BOTH TIME AND MONEY.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PRESENTED WITH VARIOUS COMPONENTS OF THE CARBURETION SYSTEM OR SPECIFIC PARTS OF THE CARBURETOR, CORRECTLY IDENTIFY ALL THE COMPONENTS OR PARTS AND DESCRIBE THE FUNCTION OF THE COMPONENT OR PART IN THE CARBURETION SYSTEM TO THE SATISFACTION OF THE TEACHER.
2. WHEN PROVIDED WITH A SMALL GASOLINE ENGINE WITH OPERATING SYMPTOMS THAT MAY BE CAUSED BY DEFECTS IN THE CARBURETION SYSTEM, DIAGNOSE THE NATURE OF THE MALFUNCTION(S) FOLLOWING APPROVED TROUBLESHOOTING PROCEDURES.
3. WHEN PROVIDED WITH A SMALL GASOLINE ENGINE WITH DEFECTS IN THE CARBURETION SYSTEM, DISASSEMBLE, REPAIR AND/OR SERVICE, REASSEMBLE, AND ADJUST THE CARBURETOR ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

B. INSTRUCTIONAL AREAS

1. DETERMINING THE FUNCTIONS OF THE CARBURETION SYSTEM COMPONENTS AND THE SPECIFIC PARTS OF THE CARBURETOR
    A. DETERMINING THE FUNCTIONS OF THE VARIOUS COMPONENTS OF THE CARBURETION SYSTEM
    B. DETERMINING THE PURPOSES OF THE VARIOUS PARTS OF THE CARBURETOR
    C. PRINCIPLES OF CARBURETION IN TWO STROKE CYCLE AND FOUR STROKE CYCLE GASOLINE ENGINES
2. IDENTIFYING DEFECTS OR SYMPTOMS ON SMALL GASOLINE ENGINES THAT MAY INDICATE DEFECTS OF VARIOUS COMPONENTS IN THE CARBURETION SYSTEM

A. PROCEDURES FOR TROUBLESHOOTING THE CARBURETION SYSTEM ON SMALL GASOLINE ENGINES

B. VISUALLY INSPECTING AND MEASURING FOR DEFECTS IN FLOAT TYPE, DIAPHRAGM TYPE, AND SUCTION LIFT CARBURETORS SUCH AS:

(1) INSPECTING AND MEASURING FOR THROTTLE SHAFT WEAR
(2) INSPECTING HIGH AND/OR IDLE SPEED ADJUSTING NEEDLES, SEATS, AND FUEL NOZZLES
(3) INSPECTING GASKETS, "O" RINGS, AND THE DIAPHRAGM
(4) INSPECTING FUEL LINES, FUEL STRAINERS, PIPES, AND THE BALL CHECK
(5) INSPECTING THE AIR CLEANER ELEMENT
(6) INSPECTING THE GOVERNOR, THE GOVERNOR LINKAGE AND THROTTLE LINKAGE

3. CORRECTING THE PROBLEMS IN THE CARBURETION SYSTEM

A. PROCEDURES TO FOLLOW IN REPAIRING AND SERVICING THE FUEL TANK AND GASOLINE SUPPLY LINES

B. PROCEDURES TO FOLLOW IN SERVICING THE AIR CLEANER COMPONENT

C. PROCEDURES TO FOLLOW IN DISASSEMBLING, INSPECTING, REPAIRING, SERVICING, REASSEMBLING AND MAKING INITIAL CARBURETOR ADJUSTMENTS ON SMALL GASOLINE ENGINES

(1) REMOVING AND REPLACING NEEDLE SEATS, FUEL NOZZLE, AND ADJUSTING NEEDLES
(2) REPLACING GASKETS AND ADJUSTING THE FLOATS
(3) ADJUSTING GOVERNOR LINKAGE AND THROTTLE LINKAGE

D. PROCEDURES TO FOLLOW IN MAKING FINAL CARBURETOR ADJUSTMENTS ON SMALL GASOLINE ENGINES

(1) MAKING FINAL ADJUSTMENTS ON THE LOW SPEED ADJUSTMENT NEEDLE
(2) MAKING FINAL ADJUSTMENTS ON THE HIGH SPEED ADJUSTMENT NEEDLE
(3) ADJUSTING THE IDLE STOP SCREW

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING A PAPER SKETCH OF A CROSS SECTION OF A CABURETOR, HAVE EACH STUDENT SHOW THE FLOW OF AIR AND FUEL IN THE CARBURETOR WHEN THE ENGINE IS CHOKED FOR STARTING USING A BLUE PENCIL FOR AIR AND A RED PENCIL FOR FUEL.

2. HAVE SEVERAL ENGINES PREPARED WITH CARBURETOR TROUBLES. WITH THE STUDENTS WORKING IN TEAMS OF TWO IN THE SCHOOL SHOP, HAVE THEM DIAGNOSE WHAT THE PROBLEM(S) MAY BE IN THE CARBURETION SYSTEM THAT MAY BE CAUSING OR CONTRIBUTING TO THE SYMPTOMS THAT ARE OBSERVED WHEN THE ENGINE IS OPERATING OR NOT OPERATING.

3. A. USING THE VARIOUS AIR CLEANER ELEMENTS FOUND ON SMALL GASOLINE ENGINES SUCH AS THE OIL BATH, OILED FOAM ELEMENTS, AND DRY MESH ELEMENTS, HAVE THE STUDENTS DISASSEMBLE THE AIR CLEANER AND SERVICE THE ELEMENTS ACCORDING TO THE SPECIFICATIONS IN THE OPERATOR'S MANUAL.

   B. USING A SMALL CAN OF WATER, RULERS OR STRAIGHTEDGES AND VARIOUS TYPES OF FLOATS USED IN CARBURETORS, HAVE THE STUDENTS CHECK THE FLOATS FOR LEAKS, AND HAVE THEM ADJUST THE FLOAT LEVEL TO THE SPECIFICATIONS IN THE SERVICE MANUAL.

   C. USING A SUCTION-TYPE CARBURETOR, A VISE, AND SEVERAL SCREWDRIVERS, HAVE THE STUDENTS REMOVE THE FUEL PIPE FROM THE CARBURETOR, TEST THE BALL CHECK AND SCREEN IF NECESSARY IN A LIQUID SOLVENT, AND REASSEMBLE THE FUEL PIPE TO THE CARBURETOR.

   D. HAVE THE STUDENTS DEMONSTRATE THE PROCEDURES TO FOLLOW IN MAKING THE FINAL ADJUSTMENTS ON A CARBURETOR BY USING THE TACHOMETER TO SET THE IDLE SPEED ADJUSTING SCREW AND BY ADJUSTING THE IDLE MIXTURE NEEDLE VALVE AND THE HIGH SPEED NEEDLE VALVE ON AN ENGINE WITH A FLOAT TYPE CARBURETOR.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A LIST OF MATCHING ITEMS - ONE COLUMN BEING PARTS OF THE CARBURETOR OR COMPONENTS OF THE CARBURETION AND FUEL SYSTEM, AND ANOTHER COLUMN BEING FUNCTIONS OR PURPOSES OF THE PARTS AND HAVE THE STUDENTS COMPLETE THE MATCHING EXERCISE.

2. FROM A LIST OF ENGINE SYMPTOMS, SOME OF WHICH MAY BE INDICATIVE OF MALFUNCTIONS IN THE CARBURETION SYSTEM, HAVE THE STUDENTS IDENTIFY THOSE ENGINE SYMPTOMS THAT ARE MOST LIKELY TO BE CAUSED BY DEFECTS IN THE CARBURETION SYTEM ON SINGLE CYLINDER ENGINES.

3. PROVIDE THE STUDENT WITH SPECIFIC INFORMATION REGARDING MODEL NUMBER, TYPE OF ENGINE, AND TYPE OF CARBURETOR AND, BY USING A SERVICE MANUAL, HAVE THE STUDENT LOCATE AND MAKE THE PROPER INITIAL ADJUSTMENT FOR THE IDLE MIXTURE NEEDLE, THE HIGH SPEED ADJUSTMENT NEEDLE, OR FOR ONLY THE HIGH SPEED ADJUSTMENT NEEDLE WHEN THE CARBURETOR IS SO EQUIPPED.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EXAMPLES OF VARIOUS TYPES OF CARBURETION SYSTEMS FOR STUDENTS TO WORK ON
2. EXAMPLES OF DAMAGED HIGH AND IDLE SPEED ADJUSTMENT NEEDLES
3. EXAMPLES OF VARIOUS TYPES OF AIR CLEANERS USED ON SMALL GAS ENGINES
4. EXAMPLES OF VARIOUS TYPES OF GOVERNORS USED ON SMALL GASOLINE ENGINES
5. APPROPRIATE SMALL HAND TOOLS INCLUDING FEELER GAUGE, TACHOMETER, AND SPECIAL TOOLS NEEDED TO WORK ON THE CARBURETORS OF VARIOUS MODELS OF ENGINES

F. EXAMPLES OF SUPPORTING REFERENCES

1. ENGINE THEORY STUDENT ACTIVITY MANUAL. ST. PAUL, MINNESOTA: TECHNICAL SYSTEMS, INC. 1972, PP. 5-1, 5-11.

   WRITTEN TO BE DIRECTLY USED BY STUDENTS, THIS PUBLICATION CONTAINS WRITTEN STUDENT EXERCISES AND PROCEDURES TO OBSERVE ON SUCH AREAS AS THE AIR-FUEL RATIO, PRINCIPLES OF CARBURETION, FLOW OF FUEL, AIR, THE FUEL-AIR MIXTURE IN THE CARBURETOR, AND CARBURETOR DISASSEMBLY AND ASSEMBLY.

2. GENERAL THEORIES OF OPERATION. MILWAUKEE, WISCONSIN: BRIGGS AND STRATTON CORPORATION.

   STUDENTS WILL FIND THIS REFERENCE EASY TO READ AND COMPREHEND AS IT TAKES THE STUDENT THROUGH THE PROCESS OF MOVING THE AIR AND FUEL MIXTURE INTO THE COMBUSTION CHAMBER.

3. SMALL ENGINES: CARE-OPERATION-MAINTENANCE AND REPAIR, VOLUME I AND II. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION FOR VOCATION INSTRUCTIONAL MATERIALS. 1968, 150 PAGES.

   THESE PUBLICATIONS COVER THE VARIOUS TYPES OF CARBURETION SYSTEMS AND OUTLINE IN A VERY CONCISE MANNER THE STEPS TO FOLLOW IN REPAIRING THE CARBURETORS, THE AIR CLEANERS, AND THE GOVERNOR SYSTEM.

4. SMALL ENGINES - PRINCIPLES OF OPERATION, TROUBLESHOOTING, AND TUNE-UP. VAS 3014. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1962, 16 PAGES.

   THIS PUBLICATION TAKES THE VARIOUS COMPONENTS OF THE CARBURETION SYSTEM AND DISCUSSES AND ILLUSTRATES THE PURPOSE AND OPERATION OF EACH COMPONENT.

5. SMALL ENGINES SERVICE MANUAL. KANSAS CITY, MISSOURI: TECHNICAL PUBLICATIONS DIVISION, INTERTEC PUBLISHING CORPORATION. 1969, 328 PAGES.

   INCLUDED IN THIS PUBLICATION IS A VERY BRIEF DISCUSSION OF THE PRINCIPLES OF CARBURETION AND IN ADDITION, PROVIDES THE TECHNICAL INFORMATION NEEDED TO REPAIR AND ADJUST THE CARBURETORS ON NUMBEROUS ENGINE MODELS.

SERVICING AND REPAIRING THE OIL LUBRICATION SYSTEM ON SMALL GASOLINE ENGINES

UNIT CONCEPT: PROPERLY SERVICING OR REPAIRING THE LUBRICATION SYSTEM ON SMALL GASOLINE ENGINES WILL AID IN MINIMIZING ENGINE WEAR AND PROLONGING ENGINE LIFE UNDER VARIOUS OPERATING CONDITIONS. THIS IS ACCOMPLISHED BY USING OIL AS A LUBRICANT TO REDUCE FRICTION BETWEEN MOVING PARTS WHICH REDUCES HEAT AND INCREASES POWER, PREVENTS CORROSION, AND CLEANS IMPURITIES FROM ENGINE PARTS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PRESENTED WITH AN ENGINE WITH SYMPTOMS THAT MAY BE CAUSED ENTIRELY, OR TO SOME EXTENT, BY DEFECTS IN THE OIL LUBRICATION SYSTEM, DIAGNOSE THE NATURE OF THE MALFUNCTION(S) FOLLOWING APPROVED PROCEDURES.

2. WHEN PROVIDED WITH A SMALL GASOLINE ENGINE WITH DEFECTS IN THE OIL LUBRICATION SYSTEM, DISASSEMBLE, REPAIR AND/OR SERVICE, AND REASSEMBLE THE OIL SYSTEM USED ON THE ENGINE FOLLOWING PROCEDURES OUTLINED IN THE SERVICE MANUAL.

3. WHEN PROVIDED WITH A FOUR STROKE CYCLE ENGINE THAT NEEDS TO HAVE THE OIL CHANGED IN THE CRANKCASE, REMOVE THE OIL FROM THE CRANKCASE FOLLOWING PROCEDURES DETAILED IN THE SERVICE OR OPERATOR'S MANUAL.

4. WHEN GIVEN A SMALL GASOLINE FOUR STROKE CYCLE ENGINE, CHECK THE OIL LEVEL IN THE CRANKCASE AND ADD THE PROPER AMOUNT OF THE PROPER OIL DESCRIBED IN EITHER THE OPERATOR'S MANUAL OR ON THE ENGINE NAMEPLATE.

B. INSTRUCTIONAL AREAS

1. DETERMINING THE PURPOSE OF THE LUBRICATION SYSTEM
   - A. DETERMINING HOW OIL HELPS TO REDUCE ENGINE WEAR AND TO INCREASE USEFUL LIFE OF THE ENGINE
   - B. IDENTIFYING DIFFERENT TYPES OF OIL LUBRICATION SYSTEM USED ON FOUR STROKE CYCLE GASOLINE ENGINES AND THE FLOW OF OIL IN SUCH ENGINES

C. IDENTIFYING THE TYPE OF OIL LUBRICATION SYSTEM USED ON TWO STROKE CYCLE ENGINES AND THE FLOW OF OIL IN SUCH ENGINES

2. IDENTIFYING THE DEFECTS OR SYMPTOMS ON SMALL GASOLINE ENGINES THAT MAY INDICATE DEFECTS IN THE OIL LUBRICATION SYSTEM

   A. PROCEDURES FOR TROUBLESHOOTING THE OIL LUBRICATION SYSTEM

   B. VISUALLY INSPECTING FOR DEFECTS IN THE OIL LUBRICATION SYSTEM

      (1) VISUALLY INSPECTING PARTS IN THE INTERNAL COMBUSTION ENGINE THAT MAY INDICATE EXCESSIVE DIRT IN THE OIL
      (2) VISUALLY INSPECTING THE ENGINE AND SPECIFICALLY THE PISTON AND CYLINDER WALLS FOR SEIZING
      (3) VISUALLY INSPECTING THE BEARINGS OR BUSHINGS FOR BURNING
      (4) RECOGNIZING EXTERNAL SIGNS OF OVERHEATING DUE TO LACK OF OIL
      (5) RECOGNIZING PROBLEMS IN THE STARTING AND RUNNING OF A TWO STROKE CYCLE ENGINE THAT MAY BE DUE TO PROBLEMS IN THE OIL SYSTEM

3. CORRECTING THE PROBLEMS IN THE OIL LUBRICATION SYSTEM

   A. PROCEDURES TO FOLLOW IN REPAIRING OR SERVICING THE OIL SYSTEM ON FOUR STROKE CYCLE ENGINES

      (1) PROCEDURES TO FOLLOW IN REMOVING AND REPLACING THE OIL DIPPER OR OIL SLINGER SYSTEM
      (2) PROCEDURES TO FOLLOW IN REMOVING, DISASSEMBLING, SERVICING AND REASSEMBLING GEAR OIL PUMPS OR PLUNGER-TYPE PUMPS ON FOUR STROKE CYCLE ENGINES

   B. PROCEDURES TO FOLLOW IN CHANGING THE CRANKCASE OIL ON A FOUR STROKE CYCLE

      (1) RUNNING THE ENGINE TO WARM THE CRANKCASE
      (2) REMOVING THE OIL

   C. ADDING OIL TO THE CRANKCASE ON A FOUR STROKE CYCLE

      (1) CHECKING THE CRANKCASE OIL LEVEL
      (2) SELECTING THE PROPER OIL TO BE ADDED TO THE CRANKCASE
      (3) ADDING THE OIL TO THE APPROPRIATE LEVEL

D. PROCEDURES TO FOLLOW IN SERVICING THE OIL SYSTEM ON TWO STROKE CYCLE ENGINES

(1) MIXING THE GASOLINE AND OIL MIXTURE USING THE PROPER OIL AND IN THE PROPER PROPORTION

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. A. USING A PAPER SKETCH OF THE CROSS SECTION OF A TWO STROKE CYCLE AND A FOUR STROKE CYCLE GASOLINE ENGINE AND COLORED PENCILS, HAVE THE STUDENTS TRACE THE FOLOW OF OIL IN THE TWO TYPES OF ENGINES.

B. HAVE THE PARTS OF SEVERAL ENGINES, WHICH SHOW SYMPTOMS OR PROBLEMS IN THE OIL LUBRICATION SYSTEM SUCH AS BEARINGS, BUSHINGS, RINGS AND PISTONS, CYLINDER BLOCK AND CONNECTING RODS, DISPLAYED FOR THE STUDENTS TO VIEW. WITH THE STUDENTS WORKING IN TEAMS OF TWO IN THE SCHOOL SHOP, HAVE THEM DIAGNOSE WHAT PROBLEMS IN THE OIL LUBRICATION SYSTEM MAY HAVE CAUSED OR CONTRIBUTED TO THE APPEARANCE OF SYMPTOMS IN THE PARTS. THE STUDENTS MAY DESIRE TO USE REFERENCES OR PICTURES FROM REFERENCES TO HELP THEM DIAGNOSE THE NATURE OF THE PROBLEM.

2. A. HAVE THE STUDENTS REMOVE A GEAR-TYPE OIL PUMP FROM AN ENGINE AND DISCONNECT THE PIPE AND SCREEN FROM THE PUMP. AFTER THE PIPE AND SCREEN HAVE BEEN REMOVED, CLEAN THEM IN A COMMERCIAL SOLVENT AND FLUSH THE PUMP USING A COMMERCIAL SOLVENT AND AIR.

B. ON AN ENGINE WITH AN OIL DIPPER, SLINGER OR SCOOP-TYPE OF LUBRICATION SYSTEM, HAVE THE STUDENTS OPEN THE CRANKCASE AND CHECK THE POSITON OF THE SLINGER, DIPPER, OR SCOOP AGAINST AN ILLUSTRATION IN A SERVICE MANUAL.

3. USING A FOUR STROKE CYCLE ENGINE, HAVE THE STUDENTS REMOVE THE CRANKCASE OIL FROM THE ENGINE FOLLOWING APPROVED PROCEDURES SUCH AS, OPERATING THE ENGINE TO HEAT THE OIL, DISCONNECTING THE APRAK PLUG, AND REMOVING THE DRAIN PLUG.

4. A. HAVE TWO OR THREE STUDENTS CONDUCT A DEMONSTRATION FOR THE REMAINDER OF THE CLASS SHOWING THE EFFECT VISCOSITY GRADE OF OIL HAS ON THE MOVEMENT OF ENGINE PARTS THROUGH THE OIL. HAVE THE STUDENTS USE TEST TUBES, BALL BEARINGS, AND VARIOUS GRADES OF OIL TO ILLUSTRATE WHY THE VISCOSITY GRADE OF OIL MAY NEED TO BE CHANGED FOR DIFFERENT SEASONS. THE STUDENTS SHOULD ALSO DISCUSS SINGLE VISCOSITY OILS AND MULTI-VISCOSITY OILS.

B. HAVE TWO OR THREE STUDENTS DEMONSTRATE FOR THE REMAINDER OF THE CLASS, THE PROPER PROCEDURE TO FOLLOW FOR MIXING THE GAS AND OIL MIXTURE FOR A TWO STROKE CYCLE ENGINE. THE STUDENTS SHOULD BE SURE TO COVER THE MEASURING OF THE OIL FOR A GIVEN QUANTITY OF GASOLINE AND PRACTICES TO FOLLOW WHEN USING THE MIXTURE AFTER IT HAS NOT BEEN USED FOR A PERIOD OF TIME.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A LIST OF ENGINE SYMPTOMS OR PART SYMPTOMS - SOME OF WHICH MAY BE INDICATIVE OF PROBLEMS IN THE OIL LUBRICATION SYSTEM. HAVE THE STUDENTS IDENTIFY THOSE ENGINE OR PART SYMPTOMS THAT MAY HAVE BEEN CAUSED BY PROBLEMS IN THE OIL LUBRICATION SYSTEM OF SMALL GASOLINE ENGINES.

2. USING A SERIES OF ILLUSTRATIONS OF A SMALL GASOLINE ENGINE WITH AN OIL-SCOOP TYPE OF LUBRICATION SYSTEM AND, USING ARROWS TO INDICATE THE DIRECTION OF TRAVEL FOR THE CRANKSHAFT AND CAMSHAFT, HAVE THE STUDENTS IDENTIFY THE ILLUSTRATION(S) WHICH SHOW THE OIL SCOOP INSTALLED IN THE PROPER POSITION.

3. HAVE THE STUDENTS LIST THE PROCEDURES THEY WOULD FOLLOW AND THE SAFETY PRECAUTIONS THEY WOULD OBSERVE WHEN CHANGING THE CRANKCASE OIL IN A FOUR STROKE CYCLE ENGINE MOUNTED ON A ROTARY TYPE LAWN MOWER.

4. A. HAVE THE STUDENTS LIST THE PROCEDURES THEY WOULD FOLLOW FOR CHECKING THE OIL LEVEL ON A FOUR STROKE CYCLE ENGINE EQUIPPED WITH A CRANKCASE DIPSTICK.

   B. HAVE THE STUDENTS CALCULATE THE AMOUNT OF OUTBOARD MOTOR OIL TO BE MIXED WITH 2 1/2 GALLONS OF GASOLINE FOR A TWO STROKE CYCLE ENGINE USING INFORMATION PROVIDED BY THE TEACHER REGARDING THE AMOUNT OF OUTBOARD OIL TO BE MIXED WITH ONE GALLON.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EXAMPLES OF ENGINE PARTS SHOWING DAMAGE DUE TO PROBLEMS IN THE LUBRICATION SYSTEM. FOR EXAMPLE, THESE COULD BE PISTONS AND RINGS FROM AN ENGINE WHERE THE WRONG OIL HAS BEEN USED, BEARINGS OR SLEEVE BUSHINGS WHERE AN ENGINE RAN OUT OF OIL, OR A CONNECTING ROD AND BEARING CAP SHOWING WEAR RESULTING FROM USING DIRTY OIL.

2. SMALL ENGINES FOR THE STUDENTS TO WORK ON

3. EXAMPLES OF VARIOUS TYPES OF OIL LUBRICATION SYSTEMS USED ON FOUR STROKE CYCLE GASOLINE ENGINES

4. EXAMPLES OF VARIOUS GRADES OF OIL, TEST TUBES, AND BALL BEARINGS

5. VARIOUS SMALL HAND TOOLS NEEDED TO REPAIR AND SERVICE THE LUBRICATION SYSTEM SUCH AS A SOCKET SET, SCREWDRIVERS, AND OPEN AND BOX END WRENCHES

6. GAS CANS AND FUNNELS

F. EXAMPLES OF SUPPORTING REFERENCES

1. ENGINE: PRINCIPLES OF OPERATION AND ASSEMBLY. KOHLER, WISCONSIN: KOHLER COMPANY. PP. 1.16 - 1.19.

   IN SEVERAL PARAGRAPHS, THE FUNCTIONS OF THE LUBRICATION SYSTEM IS DISCUSSED IN A MANNER THAT THE STUDENT SHOULD BE ABLE TO UNDERSTAND RELATIVELY EASILY.

2. SMALL ENGINES: CARE-OPERATION-MAINTENANCE AND REPAIR, VOLUME I AND II. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS. 1968, 150 PAGES.

   THE LUBRICATION SYSTEM IS DISCUSSED IN THESE PUBLICATIONS. A STEP-BY-STEP PROCEDURE FOR REPAIRING AND/OR SERVICING THE LUBRICATION SYSTEM IS PRESENTED WITH COLORED ILLUSTRATIONS.

THE ENGINE BLOCK AND HEAD

UNIT CONCEPT: THE ENGINE BLOCK, WHICH MAY VARY IN DESIGN FROM ONE ENGINE TO ANOTHER, IS THE BASIC FRAME OF THE INTERNAL COMBUSTION ENGINE. THE VARIOUS STRESSES TO WHICH THE HEAD AND BLOCK ARE SUBJECTED MAY RESULT IN DEFECTS, SUCH AS WARPAGE AND CRACKS, WHICH MAY RESULT IN POOR ENGINE COMPRESSION AND POWER AND WATER AND OIL SEEPING INTO THE COMBUSTION CHAMBER.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED A MULTICYLINDER ENGINE WITH SYMPTOMS THAT MAY BE INDICATIVE OF PROBLEMS OR DEFECTS IN THE CYLINDER BLOCK OR HEAD, DIAGNOSE THE NATURE OF THE MALFUNCTIONS BY USING APPROPRIATE TROUBLESHOOTING AND INSPECTION PROCEDURES AS MAY BE DETAILED IN THE SERVICE MANUAL.

2. PROVIDED A MULTICYLINDER ENGINE HEAD, REMOVE THE CYLINDER HEAD AND HEAD GASKET AND INSPECT IT FOR DEFECTS FOLLOWING THE PROCEDURES DETAILED IN THE SERVICE MANUAL.

3. GIVEN A MULTICYLINDER ENGINE BLOCK, INSPECT THE CYLINDER BLOCK AND CYLINDER WALLS FOR CRACKS AND OTHER DEFECTS AND MEASURE THE CYLINDER WALLS FOR TAPERING OR OUT-OF-ROUND ACCORDING TO PROCEDURES DETAILED IN THE SERVICE MANUAL.

4. PROVIDED A MULTICYLINDER ENGINE HEAD, CLEAN THE HEAD, REPLACE THE HEAD GASKET, INSTALL THE HEAD, AND TORQUE THE ENGINE HEAD ACCORDING TO THE SPECIFICATIONS IN THE SERVICE MANUAL.

5. PROVIDED A MULTICYLINDER ENGINE BLOCK, REMOVE THE CYLINDER RIDGE WHEN NECESSARY, HONE THE CYLINDER, DEGLAZE THE CYLINDER WALLS, PULL THE CYLINDER SLEEVES, REPLACE DRY AND WET SLEEVES, AND CLEAN THE OIL PASSAGES IN THE ENGINE BLOCK FOLLOWING THE PROCEDURES IN THE SERVICE MANUAL.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND DEFECTS ON THE POWER UNIT THAT MAY INDICATE DEFECTS IN EITHER THE CYLINDER HEAD OR CYLINDER BLOCK

A. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS IN THE BLOCK AND HEAD

(1) LACK OF POWER
(2) LOSS OF WATER CAUSING OVERHEATING
(3) EXCESSIVE USE OF OIL
(4) EXCESSIVE USE OF FUEL

B. COMPONENTS OF THE BLOCK AND HEAD

(1) IDENTIFYING THE PARTS
(2) DETERMINING THEIR FUNCTION

C. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE BLOCK AND HEAD

D. GENERAL TROUBLESHOOTING PROCEDURES FOR LOCATING DEFECTS IN THE BLOCK AND HEAD

E. INSPECTING AND MEASURING FOR DEFECTS IN THE CYLINDER HEAD, HEAD GASKET, AND CYLINDER BLOCK

(1) REMOVING AND CLEANING THE CYLINDER HEAD
(2) INSPECTING THE HEAD FOR CRACKS AND CHECKING THE HEAD FOR WARPAGE
(3) INSPECTING THE HEAD GASKET FOR DEFECTS
(4) INSPECTING THE HEAD FOR CLOGGED OIL PASSAGES AND WATER PASSAGES

F. INSPECTING AND MEASURING FOR DEFECTS IN THE ENGINE BLOCK

(1) INSPECTING FOR A CRACKED ENGINE BLOCK OR HAIR-LINE FRACTURES IN THE CYLINDER WALL
(2) INSPECTING THE CYLINDER WALL SURFACE FOR A GLAZED SURFACE OR FOR A CYLINDER RIDGE
(3) MEASURING THE CYLINDERS FOR TAPER OR OUT-OF-ROUND
(4) INSPECTING THE BLOCK FOR CLOGGED OIL PASSAGES AND WATER PASSAGES

2. CORRECTING THE PROBLEMS IN THE CYLINDER HEAD AND ENGINE BLOCK

A. PROCEDURES TO FOLLOW FOR CORRECTING DEFECTS IN THE ENGINE BLOCK

(1) CLEANING OIL PASSAGE WAYS AND WATER PASSAGE WAYS IN THE BLOCK
(2) PULLING CYLINDER SLEEVES
(3) REPLACING WET SLEEVES AND DRY SLEEVES
(4) REMOVING THE CYLINDER RIDGE WITH A RIDGE REAMER

(5) DE-GLAZING AND HONING THE CYLINDER WALLS

B. PROCEDURES TO FOLLOW FOR CORRECTING DEFECTS IN THE HEAD

(1) CLEANING THE OIL PASSAGE WAYS AND THE WATER PASSAGE WAYS
(2) INSTALLING THE HEAD GASKET
(3) INSTALLING THE CYLINDER HEAD
(4) TORQUING THE HEAD ACCORDING TO THE SPECIFICATIONS IN FOOT POUND OR INCH POUNDS IN THE PROPER SEQUENCE

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING A MULTICYLINDER ENGINE IN THE SCHOOL SHOP ON WHICH THE TEACHER HAS CREATED SOME MALADJUSTMENTS IN THE ENGINE HEAD AND GASKET, HAVE THE STUDENTS LISTEN TO THE ENGINE OPERATE OR LISTEN TO THE ENGINE BEING TURNED OVER. AFTER LISTENING FOR SYMPTOMS WHILE THE ENGINE IS RUNNING OR WHILE THE ENGINE IS TURNING OVER, HAVE THE STUDENTS USE A SERVICE MANUAL TO LOCATE OR IDENTIFY POTENTIAL DEFECTS THAT MAY BE CAUSING OR CONTRIBUTING TO THE SYMPTOMS OBSERVED.

2. USING THE ENGINE HEADS FROM THE ENGINES THE STUDENTS ARE WORKING ON IN THE SHOP, HAVE THE STUDENTS CHECK THE HEAD FOR WARPAGE AT EACH END, BETWEEN ALL CYLINDERS, AND FROM END-TO-END IN AT LEAST SIX DIFFERENT PLACES BY USING A STRAIGHTEDGE AND A FEELER GAUGE.

3. USING THE ENGINE BLOCK FROM THE ENGINES THE STUDENTS ARE WORKING ON IN THE SHOP, HAVE THE STUDENTS MEASURE THE CYLINDERS TO DETERMINE THE OUT-OF-ROUND CONDITION OF THE CYLINDER AND THE TAPERING IN THE CYLINDER BY USING AN INSIDE MICROMETER.

4. USING A NEW HEAD GASKET AND THE HEAD FROM THE ENGINE THE STUDENTS ARE WORKING ON IN THE SHOP, HAVE THE STUDENTS INSTALL THE GASKET AND HEAD AND USE A TORQUE WRENCH TO TORQUE THE HEAD TO THE MANUFACTURER'S SPECIFICATIONS FOLLOWING THE APPROPRIATE SEQUENCE IN THE SERVICE MANUAL.

5. USING THE ENGINE BLOCK ON WHICH THE STUDENTS ARE WORKING IN THE SHOP, HAVE THE STUDENTS DE-GLAZE THE CYLINDER WALLS UNTIL A CROSSHATCHED PATTERN IS OBTAINED ON THE WALLS BY USING A DE-GLAZING TOOL AND AN ELECTRIC DRILL.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A COMPLETION EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN SYMPTOMS THAT WERE OBSERVED WHILE AN ENGINE WAS RUNNING OR WHILE THE ENGINE WAS BEING CRANKED. A SECOND COLUMN SHOULD CONTAIN POTENTIAL DEFECTS OR PROBLEMS IN THE ENGINE BLOCK AND/OR HEAD THAT MAY BE CAUSING OR CONTRIBUTING TO THE OBSERVED SYMPTOMS. HAVE THE STUDENTS LIST UNDER EACH SYMPTOM OBSERVED THE CAUSE(S) OR DEFECTS IN THE ENGINE BLOCK AND/OR HEAD WHICH MAY MOST LIKELY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOM(S).

2. HAVE THE STUDENTS LIST THE PROCEDURES THEY WOULD FOLLOW TO CHECK THE HEAD OF A MULTICYLINDER ENGINE FOR CRACKS AND FOR WARPING.

3. USING A CYLINDER LINER FROM AN ENGINE FOR EACH STUDENT AND A MICROMETER, HAVE EACH STUDENT CALCULATE THE AMOUNT OF TAPER FOR THE LINER WITH A TOLERANCE OF ±.005".

4. USING AN ILLUSTRATION OF A CYLINDER HEAD AND A SERVICE MANUAL FOR THE ENGINE, HAVE THE STUDENT WRITE DOWN THE PROPER TORQUE FOR THE HEAD BOLTS AND NUMBER THE BOLTS IN THE PROPER SEQUENCE FOR TORQUING USING #1 TO INDICATE THE STARTING POINT.

5. HAVE EACH STUDENT DE-GLAZE A CYLINDER LINER AND TURN IT IN FOR EVALUATION. IN EVALUATING THE STUDENT'S PERFORMANCE THE TEACHER SHOULD PAY PARTICULAR ATTENTION TO THE CROSSHATCHED PATTERN ON THE CYLINDER LINER WALLS AND THE CLEANING OF THE LINER WALL SURFACES AFTER THE DE-GLAZING PROCESS WAS COMPLETED.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. CUT-AWAY CHART OF ENGINE BLOCKS WHICH SHOW THE BASIC DIFFERENCES BETWEEN WET AND DRY SLEEVES

2. EXAMPLES OF SLEEVES FOR THE STUDENTS TO INSPECT FOR DEFECTS IN THE CYLINDER WALLS AND FOR PRACTICING TO MEASURE THE CYLINDER FOR TAPERING OR OUT-OF-ROUND

3. EXAMPLES OF HEADS AND HEAD GASKETS FOR THE STUDENTS TO INPSECT FOR DEFECTS AND TO MEASURE FOR HEAD WARPAGE

4. APPROPRIATE TOOLS AND EQUIPMENT SUCH AS A TORGUE WRENCH, COMPRESSION GAUGE, STRAIGHTEDGE METAL RULERS, FEELER GAUGE, OVERHEAD HOIST, RIDGE REAMER, CYLINDER LINER PULLERS, MICROMETERS, HONING STONE, DE-GLAZING TOOL, ELECTRIC DRILL, SOCKET SET, AND TELESCOPING GAUGES

5. CLEANING SOLVENT, CLEAN CLOTHS, LIGHT GRADE ENGINE OIL SUCH AS SAE - 10W OIL

F. EXAMPLES OF SUPPORTING REFERENCES

1. FARM TRACTORS, ENGINEERING BULLETIN FT-53A. CHICAGO, ILLINOIS: AMERICAN OIL COMPANY. PP. 39-40.

   THE TEACHER WILL FIND THIS TO BE AN ADEQUATE AND BRIEF RESOURCE FOR STUDENTS TO USE. INCLUDED IN THE DISCUSSION IS A CONTRAST BETWEEN THE EARLY AND LATER STAGES OF CYLINDER WALL WEAR.

2. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1971, PP. 2-1 - 2-5, 2-23 - 2-30.

   INCLUDED IN THIS PUBLICATION IS A UNIT FOR REMOVING THE CYLINDER HEAD, INSPECTING THE CYLINDER HEAD, AND INSTALLING THE CYLINDER HEAD. THE LATER PAGES COVER THE INSPECTION OF THE CYLINDER BLOCK AND PROCEDURES FOR INSPECTING AND MEASURING CYLINDERS, HONING AND DEGLAZING CYLINDERS, AND REMOVING AND INSTALLING CYLINDER LINERS.

3. SERVICE MANUALS FOR THE ENGINES BEING WORKED ON

   THE SERVICE MANUALS WILL GENERALLY INCLUDE A STEP-BY-STEP PROCEDURE FOR SERVICING THE ENGINE BLOCK AND CYLINDER HEAD AND WILL INCLUDE A SEQUENCE FOR TORQUING THE HEAD BOLTS.

PISTON AND CONNECTING ROD ASSEMBLY

UNIT CONCEPT: THE PISTON, PISTON RINGS AND CONNECTING ROD OPERATE AT HIGH SPEED UNDER HIGH TEMPERATURES AND OTHER STRESSES WHICH MAY RESULT IN WEAR AND DAMAGE TO THE PARTS. A PERSON WHO CAN INSPECT, REPAIR AND/OR SERVICE THE PARTS OF THE PISTON AND ROD ASSEMBLY WILL HELP TO DECREASE THE LOSS OF ENGINE POWER, MINIMIZE STARTING DIFFICULTIES AND MINIMIZE EXCESSIVE USE OF FUEL AND OIL.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH A MULTICYLINDER ENGINE WITH SYMPTOMS THAT MAY INDICATE PROBLEMS OR DEFECTS IN THE PISTON AND ROD ASSEMBLY, DIAGNOSE THE NATURE OF THE PROBLEM BY FOLLOWING APPROPRIATE TROUBLESHOOTING AND INSPECTION PROCEDURES AS DESCRIBED IN THE SERVICE MANUAL.

2. WHEN GIVEN A MULTICYLINDER ENGINE WITH DEFECTS OR MALADJUSTMENTS IN THE PISTON AND ROD ASSEMBLY, FOLLOW DIRECTIONS AND PROCEDURES DESCRIBED IN THE SERVICE MANUAL TO REMOVE AND/OR DISASSEMBLE AND INSPECT THE FOLLOWING COMPONENTS OF THE PISTON AND ROD ASSEMBLY FOR DEFECTS:

   A. PISTON
   B. PISTON RINGS
   C. WRIST PINS OR PISTON PINS
   D. CONNECTING ROD
   E. CONNECTING ROD BEARINGS

3. WHEN GIVEN AN ENGINE IN WHICH THE DEFECTS IN THE PISTON AND ROD ASSEMBLY HAVE BEEN IDENTIFIED, FOLLOW RECOMMENDED PROCEDURES IN THE SERVICE MANUAL TO REPLACE, REPAIR OR SERVICE, REASSEMBLE, ADJUST AND INSTALL THE FOLLOWING COMPONENTS OF THE ROD AND PISTON ASSEMBLY:

   A. PISTON
   B. PISTON RINGS
   C. WRIST PINS OR PISTON PINS
   D. CONNECTING ROD
   E. CONNECTING ROD BEARINGS

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND PROBLEMS THAT MAY INDICATE DEFECTS IN THE PISTON AND ROD ASSEMBLY

A. IDENTIFYING SYMPTOMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE PISTON AND ROD ASSEMBLY SUCH AS:

(1) LACK OF POWER
(2) EXCESSIVE FUEL CONSUMPTION
(3) EXCESSIVE OIL CONSUMPTION
(4) DIFFICULTY IN STARTING
(5) EXCESSIVE ENGINE NOISE

B. COMPONENTS OF THE PISTON AND ROD ASSEMBLY

(1) IDENTIFYING THE PARTS OF THE ASSEMBLY
(2) DETERMINING THE FUNCTIONS OF THE VARIOUS PARTS

C. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE PISTON AND ROD ASSEMBLY

D. GENERAL TROUBLESHOOTING PROCEDURES USED FOR THE PISTON AND ROD ASSEMBLY TO HELP LOCATE SPECIFIC PROBLEMS

E. INSPECTING AND MEASURING THE CONNECTING ROD AND BEARING

(1) MARKING AND REMOVING THE ROD AND BEARING CAP
(2) CLEANING THE ROD AND CAP
(3) VISUALLY INSPECTING THE ROD FOR DAMAGE
(4) INSPECTING THE ROD BEARING INSERTS FOR CRACKS, SCORING, SCUFFING OR ROUGH EDGES
(5) MEASURING FOR BEARING CLEARANCE BY USING MICROMETERS OR PLASTIC GAUGE

F. INSPECTING AND MEASURING THE PISTON AND PISTON RINGS

(1) DIAGNOSING THE CONDITON OF THE PISTON WHEN THE ENGINE HEAD IS REMOVED
(2) MARKING AND REMOVING THE PISTON
(3) REMOVING THE RINGS FROM EACH PISTON AND IDENTIFYING THE COMPRESSION, SCRAPER AND OIL RINGS
(4) CLEANING THE PISTON AND RINGS
(5) VISUALLY INSPECTING THE PISTON FOR SCRATCHES SCORING, SCUFFING AND BROKEN RING LANDS
(6) MEASURING RING GROOVE CLEARANCE
(7) MEASURING RING-END GAP AND DETERMINING WHY RING GAP IS IMPORTANT

- (8) DETERMINING WHEN RINGS NEED TO BE REPLACED BY CONSIDERING THE MEASUREMENTS OBTAINED AND MAKING A VISUAL INSPECTION OF THE RINGS
- (9) MEASURING PISTON DIAMETER FOR WEAR AND DETERMINING PISTON SKIRT CLEARANCE

G. INSPECTING AND MEASURING THE WRIST PIN

- (1) METHODS BY WHICH THE PIN AND PISTON ARE CONNECTED
- (2) REMOVING THE PISTON PIN AND MARKING THE PIN
- (3) INSPECTING THE PIN FOR LOOSENESS, ETCHING, SCORING OR EXCESSIVE DAMAGE
- (4) CHECKING THE PIN FOR OUT-OF-ROUNDNESS
- (5) CHECKING THE PISTON PIN BORE FOR TAPER OR BELL-MOUTHING
- (6) INSPECTING THE SNAP RINGS

2. CORRECTING THE PROBLEMS THAT HAVF BEEN DETECTED IN THE PISTON AND ROD ASSEMBLY

A. CORRECTING THE DEFECTS IN THE PISTON, PISTON RINGS AND WRIST PINS

- (1) REPLACING PISTONS WHEN NECESSARY
- (2) CHECKING RING-END GAP BEFORE INSTALLING NEW RINGS ON THE PISTON
- (3) INSTALLING THE RINGS ON THE PISTON AND DETERMINING WHY IT IS NECESSARY TO "BREAK IN" NEW PISTON RINGS
- (4) REPLACING THE WRIST PIN OR FITTING A NEW PIN
- (5) CONNECTING THE PISTON AND ROD

B. CORRECTING THE DEFECTS IN THE CONNECTING ROD AND BEARING

- (1) REPLACING THE CONNECTING ROD WHEN NECESSARY
- (2) REPLACING THE ROD BEARING INSERTS
- (3) INSTALLING THE PISTON AND ROD ASSEMBLY
- (4) CONNECTING THE ROD AND BEARING CAP TO THE CRANKSHAFT AND CHECKING THE CLEARANCE
- (5) REMOVING OR ADDING SHIMS
- (6) TORQUING THE ROD BEARING CAP

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING A MULTICYLINDER ENGINE IN THE SHOP ON WHICH THERE ARE MALADJUSTMENTS IN THE PISTON AND ROD ASSEMBLY, HAVE THE STUDENTS OBSERVE THE ENGINE OPERATE OR OBSERVE THE ENGINE BEING CRANKED. AFTER OBSERVING THE SYMPTOMS, HAVE

THE STUDENTS USE A SERVICE MANUAL TO LOCATE OR IDENTIFY POTENTIAL DEFECTS IN THE PISTON AND ROD ASSEMBLY THAT MAY BE CONTRIBUTING TO THE SYMPTOMS OBSERVED.

2. A. USING THE ENGINE IN THE SHOP ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS MARK AND REMOVE THE PISTON AND ROD ASSEMBLY FROM THE ENGINE. EACH PISTON AND ROD SHOULD BE MARKED SUCH THAT THE PISTON, ROD AND ROD BEARING CAP FOR EACH CYLINDER CAN BE IDENTIFIED.

   B. USING THE ENGINE BLOCK ON WHICH THE STUDENTS ARE WORKING IN THE SHOP AND THE OLD SET OF RINGS FROM A PISTON, HAVE THE STUDENTS MEASURE RING-END GAP WITH A FEELER GAUGE AND DETERMINE WHETHER THE END GAP READING OBTAINED FALLS WITHIN THE REGION OF REJECTION AS ESTABLISHED BY THE MANUFACTURER.

   C. USING THE CRANKSHAFT IN THE ENGINE BLOCK, A CONNECTING ROD, AND A ROD BEARING CAP FROM THE ENGINE ON WHICH THE STUDENT IS WORKING, HAVE THE STUDENT MEASURE THE ROD BEARING CLEARANCE BY USING PLASTIC GAUGE.

3. A. USING A PISTON, A NEW SET OF RINGS THE STUDENT HAS CHECKED, AND A RING EXPANDER, HAVE THE STUDENT INSTALL THE RINGS ON THE PISTON, MAKING SURE THAT THE RINGS HAVE BEEN INSTALLED IN THE PROPER RING GROOVES.

   B. USING A PISTON AND ROD PROPERLY ASSEMBLED AND READY TO BE INSTALLED IN THE CYLINDER, HAVE THE STUDENT INSTALL THE PISTON AND ROD IN THE PROPER CYLINDER USING A RING COMPRESSOR. BE SURE THE STUDENT HAS THE PISTON AND ROD ASSEMBLY TURNED IN SUCH A MANNER THAT THE ROD AND BEARING CAP ARE INSTALLED IN THE SAME POSITION AS WHEN THEY WERE ORIGINALLY REMOVED.

   C. USING A PISTON, ROD AND BEARING CAP INSTALLED IN THE CYLINDER, HAVE THE STUDENT TORQUE THE ROD BEARING CAP BOLTS TO MEET THE SPECIFICATIONS DETAILED IN THE SERVICE MANUAL.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A COMPLETION EXERCISE FOR THE STUDENTS TO COMPLETE. PRESENT THE STUDENTS WITH VARIOUS SYMPTOMS THAT WERE OBSERVED WHILE AN ENGINE WAS RUNNING OR BEING TURNED OVER. HAVE THE STUDENTS LIST UNDER EACH SYMPTOM THE DEFECT(S) IN THE PISTON AND ROD ASSEMBLY WHICH MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. A. HAVE THE STUDENT LIST FIVE SPECIFIC DETAILS HE WOULD LOOK FOR OR CONSIDER IN DETERMINING WHETHER A RING SHOULD BE REPLACED OR NOT. THE STUDENT SHOULD LIST WHAT MEASUREMENTS HE WOULD TAKE AND THE TOOLS HE WOULD USE; AND HE SHOULD ALSO LIST WHAT VISUAL INSPECTIONS HE WOULD MAKE.

   B. USING A PISTON RING AND A CYLINDER LINER, HAVE THE STUDENT DETERMINE THE AMOUNT OF RING-END GAP WITH A FEELER GAUGE. THE TOLERANCE FOR THIS EXERCISE SHOULD BE ± .001".

   C. USING A CRANKSHAFT, BEARING CAP, ROD AND PLASTIC GAUGE, HAVE THE STUDENT CALCULATE THE AMOUNT OF BEARING CLEARANCE. THE TOLERANCE FOR THIS EXERCISE SHOULD BE ± .001".

3. A. PREPARE A SERIES OF SKETCHES WHICH SHOW THE PISTON RINGS INSTALLED ON A PISTON. HAVE THE STUDENTS IDENTIFY THE SKETCHES WHICH HAVE THE RINGS INSTALLED PROPERLY, AND, ON THOSE SKETCHES WHICH DO NOT HAVE THE RINGS INSTALLED PROPERLY, HAVE THE STUDENT LIST WHAT THE PROBLEM IS.

   B. HAVE THE STUDENTS LIST THE RPOCEDURES THEY WOULD FOLLOW TO INSTALL THE PISTON, RINGS AND ROD ASSEMBLY IN THE ENGINE BLOCK. INCLUDED IN THEIR PROCEDURES SHOULD BE AN INDICATION OF THE TOOLS AND MATERIALS NEEDED AND THE POSITION OF THE PISTON AND ROD WHEN THE INSTALLATION IS MADE.

   C. USING THE REPAIRED OR SERVICED PISTON, ROD, BEARING CAP AND CRANKSHAFT IN AN ENGINE, HAVE THE STUDENT USE A SERVICE MANUAL TO DETERMINE THE AMOUNT OF TORQUE REQUIRED AND THEN TORQUE THE BEARING CAP BOLTS TO THAT SPECIFICATION.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EXAMPLES OF VARIOUS PARTS OF THE PISTON AND ROD ASSEMBLY SUCH AS PISTONS, RINGS, RODS, BEARING CAPS AND BEARING INSERTS WHICH SHOW SOME OF THE DEFECTS THAT MAY BE FOUND IN THE PISTON AND ROD ASSEMBLY

2. MULTICYLINDER ENGINES FOR THE STUDENTS TO WORK ON

3. APPROPRIATE TOOLS AND EQUIPMENT SUCH AS A FEELER GAUGE, MICROMETERS, PLASTIC GAUGE, WRENCHES, SCREWDRIVERS, PLIERS, TORQUE WRENCH, GROOVE CLEANING TOOL, RING EXPANDER, RING COMPRESSOR AND RING GROOVE WEAR GAUGE (IF AVAILABLE)

4. OIL AND CLEAN CLOTH

F. EXAMPLES OF SUPPORTING REFERENCES

1. FARM TRACTORS. ENGINEERING BULLETIN FT-53A. CHICAGO, ILLINOIS: AMERICAN OIL COMPANY. 1967.

   ALTHOUGH THE MATERIAL PRESENTED MAY NOT BE AS EASY FOR THE STUDENT TO UNDERSTAND AS SOME OTHER REFERENCES, THE TEACHER WILL FIND THIS PUBLICATION HELPFUL IN PROVIDING BACKGROUND INFORMATION FOR HIMSELF.

2. FUNDAMENTALS OF SERVICE: BEARINGS AND SEALS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1971, PP. 1-17.

   THIS PUBLICATION INCLUDES PICTURES SHOWING VARIOUS TYPES OF DEFECTS ON BEARING SURFACES AND INCLUDES A LIST OF POSSIBLE CAUSES AND REMEDIES FOR BEARING DEFECTS.

3. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, PP. 2-30, 2-48.

   THIS PUBLICATION INCLUDES A PICTORIAL PRESENTATION OF PISTON, RING AND ROD DEFECTS THAT MAY BE FOUND IN MULTI-CYLINDER GASOLINE ENGINES. IT ALSO INCLUDES A GENERAL STEP-BY-STEP PROCEDURE FOR MEASURING BEARING CLEARANCE AND FOR CHECKING PISTON-TO-CYLINDER WALL CLEARANCE.

4. SERVICE MANUALS FOR THE ENGINES BEING WORKED ON

   THESE MANUALS WILL INCLUDE TECHNICAL INFORMATION NECESSARY FOR REPAIR AND THEY WILL INCLUDE REFERENCE TO SPECIFIC PROBLEMS TO BE ENCOUNTERED OR PROCEDURES TO FOLLOW IN SERVICING A PARTICULAR ENGINE.

5. THINGS TO KNOW ABOUT ENGINE WEAR. TECHNICAL BULLETIN 61-68A. CHICAGO, ILLINOIS: AMERICAN OIL COMPANY.

   THE TEACHER WILL DISCOVER THIS TO BE A USEFUL REFERENCE FOR HIMSELF AS HE PLANS FOR THE UNIT ON THE PISTON, RINGS AND ROD DEFECTS THAT MAY CAUSE ENGINE PROBLEMS. THE TEACHER WILL FIND THE PUBLICATION MOST USEFUL IN HELPING HIM VISUALLY INSPECT ENGINE BEARINGS.

THE VALVE SYSTEM

UNIT CONCEPT: THE HIGH SPEEDS AND TEMPERATURES OF INTERNAL COMBUSTION ENGINES REQUIRE PROPER VALVE SYSTEM OPERATION TO ASSURE THAT A NEW CHARGE OF FUEL-AIR MIXTURE IS TAKEN INTO THE COMBUSTION CHAMBER AT THE PROPER TIME AND THAT THE BURNED FUEL-AIR MIXTURE IS REMOVED FROM THE COMBUSTION CHAMBER AT THE PROPER MOMENT. THIS WILL AID IN THE DEVELOPMENT OF TOP POWER WHILE AT THE SAME TIME HAVING EFFICIENT FUEL CONSUMPTION.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. GIVEN A MULTICYLINDER ENGINE WITH OBSERVABLE SYMPTOMS WHILE THE ENGINE IS OPERATING OR IS BEING CRANKED, DIAGNOSE THE NATURE OF THE DEFECT(S) IN THE VALVE ASSEMBLY OR MANIFOLD THAT IS CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOM(S) BY FOLLOWING PROPER TROUBLESHOOTING PROCEDURES.

2. GIVEN AN ENGINE WITH A DEFECT IN THE MANIFOLD, REMOVE THE MANIFOLD AND CHECK THE MANIFOLD FOR LEAKS, WARPED SURFACES, AND RESTRICTIONS IN THE PASSAGEWAYS FOLLOWING PROCEDURES DETAILED IN THE SERVICE MANUAL.

3. GIVEN AN ENGINE WITH DEFECTS OR MALADJUSTMENTS IN THE VALVE SYSTEM, FOLLOW DIRECTIONS AND PROCEDURES IN THE SERVICE MANUAL TO REMOVE AND/OR DISASSEMBLE AND INSPECT AND CHECK THE FOLLOWING COMPONENTS OF THE VALVE SYSTEM FOR DEFECTS:

   A. CAMSHAFT
   B. INTAKE AND EXHAUST VALVES
   C. VALVE GUIDES
   D. VALVE SEATS
   E. ROCKER ARM ASSEMBLY
   F. TIMING CHAIN OR GEAR

4. GIVEN AN ENGINE IN WHICH THE DEFECTS IN THE MANIFOLD HAVE BEEN IDENTIFIED, FOLLOW THE PROCEDURES IN THE SERVICE MANUAL TO SERVICE AND INSTALL THE MANIFOLD ON THE ENGINE BLOCK.

5. GIVEN AN ENGINE IN WHICH THE DEFECTS IN THE VALVE SYSTEMS HAVE BEEN IDENTIFIED, FOLLOW RECOMMENDED PROCEDURES DETAILED IN THE SERVICE MANUAL TO REPAIR OR SERVICE, REASSEMBLE, INSTALL, AND ADJUST THE FOLLOWING COMPONENTS OF THE VALVE SYSTEM:

    A. CAMSHAFT

    B. INTAKE AND EXHAUST VALVES

    C. VALVE GUIDES

    D. VALVE SEATS

    E. ROCKER ARM ASSEMBLY

    F. TIMING CHAIN OR GEAR

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS THAT MAY INDICATE DEFECTS IN THE VALVE SYSTEM

    A. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE VALVE ASSEMBLY SUCH AS:

        (1) LACK OF POWER
        (2) ENGINE RUNNING IRREGULARLY OR SURGING
        (3) DIFFICULTY IN STARTING

    B. COMPONENTS OF THE VALVE SYSTEM

        (1) IDENTIFYING THE PARTS
        (2) DETERMINING THEIR FUNCTION

    C. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE VALVE ASSEMBLY

    D. GENERAL TROUBLESHOOTING PROCEDURES USED FOR LOCATING SPECIFIC DEFECTS OR MALADJUSTMENTS IN THE VALVE ASSEMBLY

    E. INSPECTING AND MEASURING FOR DEFECTS IN THE MANIFOLD

        (1) REMOVING AND CLEANING THE MANIFOLD
        (2) INSPECTING THE MANIFOLD FOR LEAKS AND WARPED SURFACES

    F. INSPECTING AND/OR MEASURING FOR DEFECTS IN THE VALVES, VALVE GUIDES, AND VALVE SEATS

        (1) INSPECTING THE VALVE FACE AND SEAT CONTACT
        (2) MEASURING THE VALVE TAPPET CLEARANCE OR CAM FOLLOWER CLEARANCE
        (3) REMOVING VALVES FROM THE HEAD OR ENGINE BLOCK
        (4) INSPECTING THE VALVES FOR DEFECTS SUCH AS BURNING, DISHING, PITTING, OR STICKING IN THE GUIDES

(A) TYPES OF VALVES USED AND ARRANGEMENT OF THE VALVES

(5) MEASURING THE VALVE SEAT FOR RUNOUT OR OUT-OF-ROUND
(6) MEASURING VALVE MARGIN
(7) INSPECTING THE VALVE SPRINGS
(8) MEASURING VALVE GUIDE CLEARANCE

G. INSPECTING THE ROCKER ARM ASSEMBLY FOR DEFECTS

(1) LOCATING AND CHECKING THE OIL FLOW OPENINGS IN THE ROCKER ARM ASSEMBLY
(2) INSPECTING THE ROCKER ARM ASSEMBLY FOR WORN PARTS
(3) REMOVING THE ROCKER ARMS AND INSPECTING FOR SCORES, BURRS, OR EXCESSIVE WEAR

H. INSPECTING THE TIMING ASSEMBLY

(1) LOCATING THE TIMING MARKS AND CHECKING THE VALVE TIMING
(2) CHECKING THE TIMING ASSEMBLY FOR WORN GEARS
(3) REMOVING THE TIMING ASSEMBLY OR GEARS

I. INSPECTING THE CAMSHAFT ASSEMBLY FOR DEFECTS

(1) MEASURING CAMSHAFT ENDPLAY
(2) REMOVING THE PUSH RODS AND CAM FOLLOWERS
(3) INSPECTING PUSH RODS AND CAM FOLLOWERS FOR WEAR OR DAMAGE
(4) REMOVING THE CAMSHAFT FROM THE BLOCK
(5) MEASURING THE CAMSHAFT JOURNALS AND CAM LOBES FOR WEAR
(6) INSPECTING AND MEASURING CAMSHAFT BUSHINGS

2. CORRECTING THE PROBLEMS THAT HAVE BEEN DETECTED IN THE VALVE SYSTEM

A. CORRECTING THE DEFECTS IN THE CAMSHAFT ASSEMBLY

(1) REPLACING THE CAMSHAFT AND HAVING THE CAMSHAFT BUSHINGS REPLACED
(2) INSTALLING THE CAMSHAFT
(3) REPLACING AND INSTALLING PUSH RODS AND CAM FOLLOWERS
(4) ADJUSTING CAMSHAFT ENDPLAY

B. CORRECTING DEFECTS IN THE TIMING ASSEMBLY

(1) REPLACING WORN TIMING GEARS

   - (2) INSTALLING TIMING GEARS FROM THE TIMING ASSEMBLY
   - (3) TIMING THE VALVE ASSEMBLY

C. CORRECTING THE DEFECTS IN THE ROCKER ARM ASSEMBLY

   - (1) CLEANING THE OIL HOLES IN THE ROCKER ARMS AND THE ROCKER ARM MOUNTING BRACKETS
   - (2) REPLACING THE ROCKER ARM(S)
   - (3) INSTALLING THE ROCKER ARMS AND SPRINGS

D. CORRECTING THE DEFECTS IN THE VALVES, VALVE GUIDES, AND VALVE SEATS

   - (1) GETTING VALVE SEATS AND VALVES GROUND WHEN NECESSARY OR REPLACING THE VALVE SEATS
   - (2) CLEANING VALVE GUIDES AND HAVING THE VALVE GUIDES REPLACED WHEN NECESSARY
   - (3) REPLACING THE VALVES AND INSTALLING THE VALVES IN THE ENGINE
   - (4) ADJUSTING VALVE TAPPET CLEARANCE

E. CORRECTING THE DEFECTS IN THE MANIFOLD

   - (1) CLEANING THE MANIFOLD
   - (2) REPLACING THE MANIFOLD IF NECESSARY AND INSTALLING THE MANIFOLD

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING A MULTICYLINDER ENGINE IN THE SHOP ON WHICH THERE ARE MALADJUSTMENTS IN THE VALVE SYSTEM, HAVE THE STUDENTS LISTEN TO THE ENGINE OPERATE OR LISTEN TO THE ENGINE BEING CRANKED. AFTER OBSERVING SYMPTOMS, HAVE THE STUDENTS USE A SERVICE MANUAL TO LOCATE OR IDENTIFY POTENTIAL DEFECTS IN THE VALVE SYSTEM THAT MAY BE CONTRIBUTING TO THE SYMPTOMS OBSERVED.

2. USING THE MANIFOLD FROM THE ENGINE THE STUDENTS ARE WORKING ON IN THE SHOP, HAVE THE STUDENTS CHECK THE MANIFOLD FOR WARPAGE BY USING STRAIGHTEDGES AND FEELER GAUGES.

3. A. USING THE ENGINE IN THE SHOP ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS VISUALLY INSPECT THE VALVES FOR ANY DEFECTS SUCH AS WARPING, BURNING, NECKING OR PITTING. IN ADDITION, HAVE THE STUDENTS MEASURE THE MARGINS OF THE VALVES AND MAKE A DECISION ON WHETHER TO REPLACE THE VALVE FOLLOWING THE SPECIFICATIONS AS DETAILED IN THE SERVICE MANUAL.

B. USING THE ENGINE IN THE SHOP ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS LOCATE THE TIMING MARKS FOR THE VALVE SYSTEM AND DETERMINE WHETHER THE VALVE SYSTEM IS PROPERLY OR IMPROPERLY TIMED.

C. USING THE CAMSHAFT FROM THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS MEASURE THE CAMSHAFT JOURNALS WITH A MICROMETER TO DETERMINE THE AMOUNT OF WEAR.

4. USING A MANIFOLD FROM THE ENGINE ON WHICH THE STUDENTS ARE WORKING IN THE SHOP, HAVE THE STUDENTS INSTALL THE MANIFOLD ON THE ENGINE.

5. A. USING THE ROCKER ARM ASSEMBLY FROM THE ENGINE ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS CLEAN THE OIL HOLES IN THE ARMS AND MOUNTING BRACKETS, ASSEMBLE THE ARMS AND SPRINGS, AND CHECK TO MAKE SURE THE OIL PASSAGES ARE ALIGNED.

B. USING THE VALVE SYSTEM IN THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS ADJUST THE VALVE TAPPET OR CAM FOLLOWER CLEARANCE ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. A. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN SYMPTOMS THAT WERE OBSERVED. A SECOND COLUMN SHOULD CONTAIN POTENTIAL DEFECTS IN THE VALVE SYSTEM. HAVE THE STUDENTS COMPLETE THE MATCHING EXERCISE BY MATCHING THE POTENTIAL DEFECT(S) WITH THE SYMPTOM.

B. USE PARTS FROM THE VALVE SYSTEM THAT SHOW VARIOUS DEFECTS IN THE VALVE SYSTEM SUCH AS BURNED OR WARPED VALVES OR WORN ROCKER ARMS OR CAMSHAFT BUSHINGS. HAVE THE STUDENTS LIST WHAT THE DEFECT OBSERVED IN THE PART IS AND THEN INDICATE WHAT MAY HAVE CAUSED THE DEFECT TO APPEAR. FOR EXAMPLE, IF THE VALVE WOULD BE WARPED, ONE OF THE CAUSES THAT MAY HAVE RESULTED IN THE WRAPING WOULD BE AN INADEQUATE TAPPET CLEARANCE.

2. HAVE THE STUDENT LIST THE PROCEDURES HE WOULD FOLLOW TO CHECK A MANIFOLD FOR CRACKS OR WARPED SURFACES ON A GASOLINE ENGINE.

3. A. USING A VALVE FROM AN ENGINE FOR EACH STUDENT AND A MICROMETER OR A RULER AND CALIPER, HAVE THE THE STUDENT DETERMINE THE AMOUNT OF MARGIN ON THE VALVE. THEN HAVE THE STUDENT DECIDE WHETHER THE VALVE SHOULD BE REJECTED ON THE BASIS OF THE MARGIN MEASUREMENT ACCORDING TO THE SPECIFICATIONS PROVIDED BY THE TEACHER.

B. USING A VALVE FROM AN ENGINE FOR EACH STUDENT AND A MICROMETER, HAVE THE STUDENT CALCULATE WITH A TOLERANCE OF ±.005" THE VALVE-GUIDE CLEARANCE. THE TEACHER WILL NEED TO PROVIDE MEASUREMENTS FOR THE VALVE GUIDE.

4. HAVE THE STUDENTS LIST THE PROCEDURES HE WOULD FOLLOW TO INSTALL A MANIFOLD AND WHY IT IS IMPORTANT THAT THERE ARE NO RESTRICTIONS IN THE MANIFOLD OR LEAKS IN THE MANIFOLD.

5. A. HAVE THE STUDENT LIST THE PROCEDURES HE WOULD FOLLOW TO ADJUST THE VALVE TAPPET CLEARANCE ON A GIVEN ENGINE. IN ADDITION, HAVE THE STUDENT LOCATE THE INTAKE AND EXHAUST TAPPET CLEARANCES FOR A SPECIFIC ENGINE.

B. PREPARE A SERIES OF FOUR SKETCHES OF THE VALVE TIMING ASSEMBLY WHICH SHOWS THE GEARS, THE TIMING MARKS, AND THE GEAR RATIO. HAVE THE STUDENTS IDENTIFY WHICH SKETCH(ES) REPRESENT A PROPERLY TIMED VALVE ASSEMBLY, AND FOR THE SKETCH(ES) THAT (IS, ARE) NOT TIMED CORRECTLY, HAVE THE STUDENTS DESCRIBE WHAT PROCEDURES THEY WOULD FOLLOW TO TIME THE VALVE ASSEMBLY.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT.

1. CUT-AWAY CHARTS OF ENGINE BLOCKS AND HEADS SHOWING THE VALVE SYSTEM AND THE DIFFERENT TYPES OF VALVE ARRANGEMENTS

2. EXAMPLES OF VARIOUS PARTS FROM THE VALVE SYSTEM, SUCH AS VALVES, ROCKER ARMS, TIMING GEARS AND PUSH RODS FOR THE STUDENTS TO INSPECT FOR DEFECTS AND TO USE IN MAKING PRECISION MEASUREMENTS WITH A MICROMETER

3. APPROPRIATE TOOLS AND EQUIPMENT, SUCH AS A FEELER GAUGE, MICROMETERS, TELESCOPING GAUGES, DIAL INDICATOR, VALVE GUIDE CLEANING TOOLS, ELECTRIC DRILL, RULERS AND OTHER STRAIGHTEDGES, VALVE SEAT PULLER AND DRIVER, VALVE REMOVAL TOOL, WRENCHES, SCREWDRIVERS AND PLIERS

F. EXAMPLES OF SUPPORTING REFERENCES

1. FARM TRACTORS, ENGINEERING BULLETIN FT-53A. CHICAGO, ILLINOIS: AMERICAN OIL COMPANY. 1967, PP. 31-38.

INCLUDED IN THIS PUBLICATION IS A SEQUENCE DESCRIBING THE PROPER PROCEDURE TO FOLLOW IN ADJUSTING VALVE CLEARANCE.

2. FARM TRACTOR TUNE-UP. VAS 3008. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, THE UNIVERSITY OF ILLINOIS. 1958, PP. 1-5.

   THIS PUBLICATION PRESENTS AN EXCELLENT DISCUSSION ON HOW TO MAKE A COMPRESSION TEST AND VACUUM TEST AND HOW TO INTERPRET THE RESULTS TO AID IN TROUBLESHOOTING OF THE ENGINE.

3. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, 286 PAGES.

   THIS IS A GOOD GENERAL REFERENCE WHICH ILLUSTRATIVELY AND DESCRIPTIVELY PRESENTS AN OVERVIEW OF THE VALVE SYSTEM AND DEFECTS THEREIN THAT THE STUDENT SHOULD BE ABLE TO UNDERSTAND.

4. SERVICE MANUALS FOR THE ENGINES BEING WORKED ON

   THESE PUBLICATIONS WILL PRESENT A STEP-BY-STEP PROCEDURE FOR SERVICING THE VALVE SYSTEM FOR THAT PARTICULAR ENGINE AND WILL INCLUDE SPECIFIC TOLERANCES NEEDED FOR PROPER REPAIR.

CRANKSHAFT AND FLYWHEEL ASSEMBLY

UNIT CONCEPT: VARIOUS DESIGNS OF CRANKSHAFTS AND A FLYWHEEL ARE USED ON THE ENGINE TO CHANGE UP-AND-DOWN MOTION INTO CIRCULAR POWER, TO PROVIDE BETTER BALANCE, AND INSURE SMOOTH OPERATION. THE SERVICING OF THE CRANKSHAFT, FLYWHEEL AND MAIN BEARINGS IN THE ENGINES AS WEAR OR DAMAGE TO THESE PARTS OCCURS WILL RESULT IN MAINTAINING OPTIMAL ENGINE POWER, MAINTAINING ADEQUATE OIL PRESSURE, AND MINIMIZING EXCESSIVE ENGINE KNOCK.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN GIVEN AN ENGINE WITH OBSERVABLE SYMPTOMS OF CRANKSHAFT OR FLYWHEEL PROBLEMS, DIAGNOSE THE NATURE OF THE DEFECT(S) IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY BY FOLLOWING PROPER TROUBLESHOOTING PROCEDURES DETAILED IN A SERVICE MANUAL.

2. WHEN GIVEN AN ENGINE WITH DEFECTS OR MALADJUSTMENTS IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY, FOLLOW DIRECTIONS AND PROCEDURES IN THE SERVICE MANUAL TO REMOVE AND/OR DISASSEMBLE AND INSPECT THE FOLLOWING COMPONENTS FOR DEFECTS:

    A. CRANKSHAFT
    B. MAIN BEARINGS
    C. CRANKSHAFT TIMING GEAR
    D. FLYWHEEL
    E. FLYWHEEL RING GEAR

3. WHEN GIVEN AN ENGINE IN WHICH THE DEFECTS IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY HAVE BEEN IDENTIFIED, REPAIR OR SERVICE, REASSEMBLE, INSTALL, AND ADJUST THE FOLLOWING COMPONENTS OF THE CRANKSHAFT AND FLYWHEEL ASSEMBLY:

    A. CRANKSHAFT
    B. MAIN BEARINGS
    C. CRANKSHAFT TIMING GEAR
    D. FLYWHEEL
    E. FLYWHEEL RING GEAR

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS THAT MAY INDICATE DEFECTS IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY

   A. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY SUCH AS:

      (1) EXCESSIVE ENGINE KNOCK
      (2) EXCESSIVE ENGINE VIBRATION
      (3) LOW OIL PRESSURE

   B. COMPONENTS OF THE CRANKSHAFT AND FLYWHEEL ASSEMBLY

      (1) IDENTIFYING THE PARTS
      (2) DETERMINING THEIR FUNCTION

   C. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY

   D. GENERAL TROUBLESHOOTING PROCEDURES USED FOR LOCATING SPECIFIC PROBLEMS IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY

   E. INSPECTING THE MAIN BEARINGS AND OIL SEALS FOR DEFECTS

      (1) MARKING AND REMOVING THE MAIN BEARING CAP
      (2) VISUALLY INSPECTING THE MAIN BEARINGS FOR DEFECTS SUCH AS PITTING, FATIGUE, CORROSION AND SCORING
      (3) MEASURING BEARING CLEARANCES WITH PLASTIC GAUGE AND MICROMETERS
      (4) INSPECTING AND REMOVING THE FRONT AND REAR OIL SEALS

   F. INSPECTING THE FLYWHEEL AND RING GEAR FOR DEFECTS

      (1) INSPECTING THE FLYWHEEL AND RING GEAR FOR DEFECTS
      (2) REMOVING THE FLYWHEEL
      (3) REMOVING THE RING GEAR FROM THE FLYWHEEL

   G. INSPECTING AND MEASURING FOR DEFECTS IN THE CRANKSHAFT AND CRANKSHAFT GEAR

      (1) MEASURING CRANKSHAFT ENDPLAY
      (2) MEASURING BACKLASH BETWEEN THE CAM GEAR AND THE CRANKSHAFT GEAR
      (3) CHECKING THE TIMING MARKS ON THE CAM GEAR AND CRANKSHAFT GEAR AND CHECKING THE CRANKSHAFT GEAR FOR WEAR, BURRS, BROKEN TEETH AND CRACKS

(4) REMOVING THE CRANKSHAFT AND CLEANING THE CRANKSHAFT
(5) CHECKING THE ALIGNMENT OF THE CRANKSHAFT
(6) MEASURING THE JOURNAL FOR OUT-OF-ROUND OR THE TAPER OF THE JOURNAL
(7) INSPECTING THE CRANKSHAFT JOURNALS FOR EXCESSIVE WEAR, PITTING, SCRATCHING, OR OTHER DAMAGE
(8) CHECKING FOR RIDGES ON THE CRANKSHAFT JOURNAL AND DETERMINING WHEN TO HAVE THE CRANKSHAFT GROUND

2. CORRECTING THE PROBLEMS THAT MAY HAVE BEEN DETECTED IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY

A. CORRECTING THE DEFECTS IN THE CRANKSHAFT AND CRANKSHAFT GEAR

(1) REPLACING THE CRANKSHAFT GEAR, IF NEEDED
(2) INSTALLING THE SAME CRANKSHAFT OR INSTALLING A REGROUND CRANKSHAFT
(3) TIMING THE CRANKSHAFT GEAR WITH THE REMAINING GEARS IN THE TIMING ASSEMBLY
(4) CHECKING CRANKSHAFT ENDPLAY

B. CORRECTING THE DEFECTS IN THE FLYWHEEL AND RING GEAR

(1) INSTALLING THE RING GEAR ON THE FLYWHEEL
(2) INSTALLING THE FLYWHEEL

C. CORRECTING THE DEFECTS IN THE MAIN BEARINGS AND THE OIL SEALS

(1) REPLACING THE FRONT AND/OR REAR OIL SEAL
(2) REPLACING THE MAIN BEARING INSERTS
(3) REMOVING OR ADDING SHIMS
(4) TORQUING THE MAIN BEARINGS

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING AN ENGINE IN THE SCHOOL SHOP WITH DEFECTS IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY, HAVE THE STUDENTS OBSERVE THE ENGINE IN OPERATION. AFTER OBSERVING THE VARIOUS SYMPTOMS, HAVE THE STUDENTS USE A SERVICE MANUAL TO LOCATE OR IDENTIFY POTENTIAL DEFECTS IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY THAT MAY BE CONTRIBUTING TO THE SYMPTOMS OBSERVED.

2. A. USING THE CRANKSHAFT FROM THE ENGINE ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS MEASURE THE CRANKSHAFT JOURNAL FOR OUT-OF-ROUNDNESS OR TAPER USING AN OUTSIDE MICROMETER.

B. USING THE CRANKSHAFT, MAIN BEARING CAP AND PLASTIC GAUGE, HAVE THE STUDENT MEASURE THE MAIN BEARING CLEARANCES FOR THE ENGINE ON WHICH HE IS WORKING.

3. A. USING THE ENGINE ON WHICH THE STUDENT IS WORKING, HAVE THE STUDENT REPLACE THE MAIN BEARING INSERTS (IF NEEDED) AND CHECK THE BEARING CLEARANCE USING PLASTIC GAUGE.

   B. HAVE THE STUDENT TORQUE THE MAIN BEARING CAPS ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS FOR THE ENGINE ON WHICH HE IS WORKING.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A COMPLETION EXERCISE FOR THE STUDENTS. IN A PROBLEM-TYPE SITUATION, DESCRIBE FOR THE STUDENT THE SYMPTOMS THAT WERE OBSERVED WHILE AN ENGINE WAS OPERATING. HAVE THE STUDENT LIST FOR EACH SYMPTOM THE POTENTIAL DEFECTS IN THE CRANKSHAFT AND FLYWHEEL ASSEMBLY THAT MAY HAVE CONTRIBUTED TO THE APPEARANCE OF THE SYMPTOM.

2. A. PROVIDE EACH STUDENT WITH A MICROMETER THAT HAS BEEN PREPARED BY THE INSTRUCTOR TO INDICATE A CERTAIN MEASUREMENT OBTAINED WHEN MEASURING THE MAIN BEARING JOURNAL DIAMETER ON A GIVEN ENGINE. HAVE EACH STUDENT READ THE MICROMETER AND WRITE ON A PIECE OF PAPER WHAT THE MEASUREMENT ON THE MICROMETER IS. HAVE EACH STUDENT THEN USE A SERVICE MANUAL FOR THE SPECIFIC ENGINE, LOCATE THE TOLERANCE INDICATED IN THE MANUAL AND WRITE DOWN THE RANGE OBTAINED FROM THE SERVICE MANUAL. THE STUDENT SHOULD THEN DETERMINE WHETHER THE MEASUREMENT FROM THE MICROMETER FALLS WITHIN THE TOLERANCE RANGE, FALLS BELOW THE RANGE OR FALLS ABOVE THE RANGE.

   B. USING SEVERAL BEARING CAPS OR MAIN BEARING INSERTS THAT SHOW VARIOUS TYPES OF DAMAGE OR DEFECTS IN BEARINGS, HAVE THE STUDENTS IDENTIFY THE TYPE OF DEFECTS THE BEARINGS REPRESENT AND HAVE THEM LIST THE POTENTIAL CAUSE OF THE DEFECT.

3. HAVE THE STUDENTS LIST THE PROCEDURES THEY WOULD FOLLOW FOR INSTALLING A CRANKSHAFT INCLUDING ANY SPECIAL PRECAUTIONS THEY WOULD OBSERVE AND TOOLS OR MATERIALS THEY WOULD NEED.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. ENGINES FOR THE STUDENTS TO WORK ON

2. CHARTS AND ILLUSTRATIONS WHICH SHOW THE VARIOUS ARRANGEMENTS OF CRANKSHAFTS FOR INTERNAL COMBUSTION ENGINES

3. EXAMPLES OF VARIOUS MAIN BEARINGS WHICH SHOW VARIOUS TYPES OF DEFECTS THAT MAY BE OBSERVED

4. SLIDES OR ILLUSTRATIONS WHICH SHOW THE TYPE OF WEAR OR DAMAGE THAT MAY BE FOUND ON CRANKSHAFTS, THE CRANKSHAFT GEAR OR THE RING GEAR

5. APPROPRIATE TOOLS INCLUDING INSIDE AND OUTSIDE MICROMETERS, PLASTIC GAUGE, GEAR PULLERS, TORQUE WRENCH, WRENCHES, DIAL INDICATOR, SCREWDRIVERS, PLIERS, AND SPECIALIZED EQUIPMENT THAT MAY BE OBTAINED FROM A LOCAL DEALER

6. OIL, CLEANING SOLVENT AND CLEAN CLOTH

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: BEARINGS AND SEALS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1971, 86 PAGES.

   THIS PUBLICATION PRESENTS IN MUCH DETAIL THE VARIOUS TYPES OF BEARINGS AND SEALS USED ON THE INTERNAL COMBUSTION ENGINE. INCLUDED ARE PICTORIAL ILLUSTRATIONS OF DEFECTS IN SEALS AND BEARINGS AND PROCEDURES ON HOW TO REPLACE THEM.

2. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, PP. 2-48 - 2-63.

   COVERED IN THIS PUBLICATION ARE THE VARIOUS TYPES OF CRANKSHAFTS USED IN THE INTERNAL COMBUSTION ENGINE AND A STEP-BY-STEP PROCEDURE FOR DIAGNOSING AND REPAIRING BEARING FAILURES.

3. SERVICE MANUALS FOR THE ENGINES BEING WORKED ON

   THESE MANUALS WILL INCLUDE A STEP-BY-STEP PROCEDURE FOR SERVICING AND REPAIRING THE CRANKSHAFT ASSEMBLY AND WILL CONTAIN SPECIFIC TOLERANCES FOR THE ENGINE.

THE ENGINE LUBRICATION SYSTEM

UNIT CONCEPT: THE MAINTENANCE AND SERVICE OF THE LUBRICATION SYSTEM WILL AID IN REDUCING WEAR TO ENGINE PARTS BY REDUCING FRICTION BETWEEN MOVING PARTS, DISSIPATING HEAT, CLEANING AND FLUSHING PARTICLES FROM THE ENGINE AND HELPING TO DEADEN ENGINE NOISE.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN GIVEN AN ENGINE WITH SYMPTOMS OF PROBLEMS IN THE LUBRICATION SYSTEM, DIAGNOSE THE NATURE OF THE DEFECT(S) THAT MAY BE CONTRIBUTING TO THE SYMPTOMS BY FOLLOWING TROUBLESHOOTING PROCEDURES IN THE SERVICE MANUAL.

2. WHEN GIVEN AN ENGINE IN WHICH THE OIL NEEDS TO BE CHANGED AND THE FILTER REPLACED, CHANGE THE OIL, CHANGE THE FILTER, AND CLEAN THE CRANKCASE BREATHER FOLLOWING PROCEDURES DETAILED IN THE SERVICE MANUAL.

3. WHEN GIVEN AN ENGINE IN WHICH THE OIL PRESSURE GAUGE IS DEFECTIVE OR THE OIL PRESSURE NEEDS TO BE ADJUSTED, INSTALL A NEW OIL PRESSURE GAUGE AND/OR ADJUST THE OIL PRESSURE BY FOLLOWING THE PROCEDURES DETAILED IN THE SERVICE MANUAL.

4. WHEN GIVEN AN ENGINE IN WHICH THE OIL PUMP HAS BEEN DETERMINED TO BE DEFECTIVE, REMOVE AND REPLACE THE OIL PUMP ACCORDING TO THE MANUFACTURER'S DIRECTIONS.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS THAT MAY INDICATE DEFECTS OR PROBLEMS IN THE ENGINE LUBRICATION SYSTEM

   A. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE OIL LUBRICATION SYSTEM SUCH AS:

      (1) EXCESSIVE ENGINE KNOCK
      (2) OVERHEATING
      (3) LOW OIL PRESSURE

   B. COMPONENTS OF THE OIL LUBRICATION SYSTEM

      (1) IDENTIFYING THE PARTS

(2) DETERMINING THEIR FUNCTION
(3) DETERMINING THE FUNCTION OF OIL
(4) VARIOUS GRADES AND TYPES OF OIL

C. DETERMINING WHY IT IS IMPORTANT TO CHANGE OIL REGULARLY AND WHY IT IS NECESSARY TO KEEP DIRT OUT OF THE OIL SYSTEM

2. CHANGING OIL IN THE ENGINE AND SERVICING THE OIL FILTER AND CRANKCASE BREATHER

A. CHECKING THE OIL LEVEL IN THE CRANKCASE

B. DRAINING THE CRANKCASE OIL

C. REPLACING THE OIL FILTER

(1) REMOVING THE FILTER
(2) INSTALLING A NEW FILTER RECOMMENDED BY THE MANUFACTURER

D. CLEANING THE CRANKCASE BREATHER

E. FILLING THE CRANKCASE WITH THE APPROPRIATE OIL

(1) DETERMINING THE TYPE OF OIL TO ADD
(2) DETERMINING THE AMOUNT OF OIL TO ADD

3. CHANGING THE OIL PRESSURE GAUGE AND ADJUSTING THE OIL PRESSURE

A. REMOVING THE OLD OIL PRESSURE GAUGE

B. INSTALLING THE NEW PRESSURE GAUGE

C. PROCEDURES TO FOLLOW IN ADJUSTING THE OIL PRESSURE

4. REMOVING AND REPLACING THE OIL PUMP

A. DRAINING THE OIL AND REMOVING THE CRANKCASE COVER AND GASKET

B. PROCEDURES FOR REMOVING THE OIL PUMP

C. CLEANING THE INTAKE SCREEN ON THE OIL PUMP AND MAKING MINOR INSPECTIONS FOR WEAR ON THE DRIVE GEAR AND CRACKS IN THE HOUSING

D. INSTALLING A NEW OR REPAIRED OIL PUMP IN THE ENGINE

E. REPLACING THE OIL PAN AND GASKET AND FILLING THE CRANKCASE

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING AN ENGINE THAT HAS DEFECTS IN THE OIL LUBRICATION SYSTEM, HAVE THE STUDENTS OBSERVE THE SYMPTOMS WHILE THE ENGINE IS OPERATING AND THEN USE THE SERVICE MANUAL TO IDENTIFY POSSIBLE DEFECTS IN THE OIL LUBRICATION SYSTEM THAT MAY CAUSE OR CONTRIBUTE TO THE APPEARANCE OF THE SYMPTOMS.

2. USING THE ENGINE ON WHICH THE STUDENT IS WORKING, HAVE THE STUDENT CHANGE THE OIL IN THE CRANKCASE AND CHANGE THE OIL FILTER, BEING SURE TO INSTALL AN APPROPRIATE FILTER CALLED FOR IN THE SERVICE MANUAL.

3. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS ADD SHIMS OR REMOVE SHIMS ON SHIM-ADJUSTED VALVES TO DETERMINE WHAT RESULT THIS HAS ON THE READING FROM THE OIL PRESSURE GAUGE.

4. USING THE OIL PUMP FROM THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS CLEAN THE OIL PUMP SCREEN USING EITHER AIR OR A CLEANING SOLVENT.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENT TO COMPLETE. ONE COLUMN SHOULD CONTAIN A LIST OF SYMPTOMS THAT WERE OBSERVED WHEN AN ENGINE WAS OPERATING OR WHEN AN ENGINE WAS DISASSEMBLED. A SECOND COLUMN SHOULD CONTAIN POSSIBLE DEFECTS IN THE LUBRICATION SYSTEM OR CAUSES FOR THE APPEARANCE OF THE SYMPTOMS. HAVE THE STUDENTS COMPLETE THE MATCHING EXERCISE.

2. HAVE THE STUDENT LIST THE PROCEDURES HE WOULD FOLLOW TO CHANGE THE OIL IN THE CRANKCASE AND TO REPLACE THE OIL FILTER. THE STUDENT SHOULD LIST THE PROCEDURES IN THE PROPER ORDER AND INDICATE THE TOOLS HE WOULD NEED.

3. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS SET OR ADJUST THE OIL PRESSURE READING TO FACTORY SPECIFICATIONS BY MAKING THE APPROPRIATE ADJUSTMENT ON A SCREW-ADJUSTING VALVE OR A SHIM-ADJUSTING VALVE.

4. HAVE THE STUDENT LIST THE PROCEDURES HE WOULD FOLLOW WHILE REMOVING THE OIL PUMP IN ORDER TO REMOVE AND INSTALL THE OIL PUMP WITHOUT DISTURBING THE ENGINE TIMING.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EXAMPLES OF TYPES OF OIL FILTERS USED ON INTERNAL COMBUSTION ENGINES

2. EXAMPLES OF OIL PRESSURE GAUGES

3. COLORED CHARTS SHOWING THE CIRCULATION OF OIL IN THE ENGINE

4. EXAMPLES OF THE VARIOUS TYPES OF OIL PUMPS THAT MAY BE USED ON INTERNAL COMBUSTION ENGINES

5. APPROPRIATE HAND TOOLS SUCH AS WRENCHES, SCREWDRIVERS, FILTER WRENCH, MASTER PRESSURE GAUGE, OIL CAN AND DRAIN PANS

6. OIL TO REFILL THE CRANKCASE

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATINNS. 1972, PP. 7-1 - 7-19.

   THIS PUBLICATION COVERS BASIC INFORMATION THAT THE STUDENTS AND TEACHER WILL FIND USEFUL FOR SERVICING THE OIL PUMP AND FOR CHECKING AND ADJUSTING THE ENGINE OIL PRESSURE.

2. SERVICE MANUALS FOR THE ENGINE BEING WORKED ON

   THESE MANUALS WILL GENERALLY INCLUDE THE PROPER PROCEDURES FOR DISASSEMBLING, INSPECTING AND REASSEMBLING THE VARIOUS COMPONENTS OF THE LUBRICATION SYSTEM.

3. TRACTOR FUELS AND LUBRICANTS: SELECTING AND STORING. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS. 1973, PP. 30-41.

   THIS PUBLICATION DISCUSSES THE PURPOSES OF OIL AS A LUBRICANT IN THE CRANKCASE INCLUDING THE VARIOUS TYPES OF OIL TO USE IN THE CRANKCASE OF SPARK IGNITION AND DIESEL ENGINES.

4. TRACTOR MAINTENANCE: PRINCIPLES AND PROCEDURES. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS. 1970, PP. 29-39.

   A STEP-BY-STEP SEQUENCE IS PRESENTED FOR CHANGING CRANKCASE OIL, REPLACING THE OIL FILTER, AND SERVICING THE CRANKCASE BREATHER.

THE IGNITION SYSTEM

UNIT CONCEPT: THE IGNITION CIRCUIT CREATES THE PROPER INTENSITY OF SPARK AT THE CORRECT TIME WHICH IGNITES THE COMBUSTIBLE MIXTURE OF AIR AND GAS. BY SERVICING AND MAINTAINING THE VARIOUS PARTS OF THE IGNITION SYSTEM, PROBLEMS SUCH AS DIFFICULTY IN STARTING, A LACK OF POWER, OVERHEATING AND MISFIRING MAY BE KEPT AT A MINIMUM, IF NOT ELIMINATED COMPLETELY.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH AN ENGINE WITH MALFUNCTIONS IN THE IGNITION SYSTEM, DIAGNOSE THE NATURE OF THE MALFUNCTIONS FOLLOWING APPROVED TROUBLESHOOTING PROCEDURES DETAILED IN THE SERVICE MANUAL.

2. WHEN PROVIDED WITH AN ENGINE WITH MALFUNCTIONS IN THE IGNITION SYSTEM, REMOVE, INSPECT AND TEST, IF NECESSARY, ACCORDING TO THE DIRECTIONS IN THE SERVICE MANUAL, THE FOLLOWING COMPONENTS OF THE IGNITION SYSTEM:

    A. SPARK PLUGS
    B. IGNITION WIRES
    C. DISTRIBUTOR
    D. COIL
    E. POINTS AND CONDENSOR
    F. BATTERY

3. WHEN PROVIDED WITH AN ENGINE ON WHICH THE PROBLEMS IN THE IGNITION CIRCUIT HAVE BEEN IDENTIFIED, REPLACE OR SERVICE, INSTALL AND ADJUST, WHEN NECESSARY, ACCORDING TO THE SPECIFICATIONS IN THE SERVICE MANUAL, THE FOLLOWING COMPONENTS OF THE IGNITION SYSTEM:

    A. SPARK PLUGS
    B. IGNITION WIRES
    C. DISTRIBUTOR
    D. COIL
    E. POINTS AND CONDENSOR
    F. BATTERY

B. INSTRUCTIONAL AREAS

1. DIAGNOSING THE NATURE OF THE DEFECTS AND MALADJUSTMENTS IN THE IGNITION SYSTEM

A. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE IGNITION SYSTEM SUCH AS:

(1) LACK OF POWER
(2) OVERHEATING
(3) MISFIRING
(4) DIFFICULTY IN STARTING

B. COMPONENTS OF THE IGNITION SYSTEM

(1) IDENTIFYING THE PARTS
(2) DETERMINING THEIR FUNCTION
(3) DETERMINING THE PRINCIPLES OF IGNITION SYSTEMS
(4) DETERMINING WHY IT IS NECESSARY TO TIME THE IGNITION SYSTEM

C. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE IGNITION SYSTEM

D. GENERAL TROUBLESHOOTING PROCEDURES USED FOR LOCATING SPECIFIC PROBLEMS IN THE IGNITION SYSTEM

2. INSPECTING AND SERVICING SPECIFIC COMPONENTS OF THE IGNITION SYSTEM

A. INSPECTING AND SERVICING THE SPARK PLUGS

(1) REMOVING AND INSPECTING THE SPARK PLUGS

(A) CHECKING TO DETERMINE IF THE PLUGS ARE FIRING
(B) CHECKING THE PLUGS FOR A FOULED OR ERODED CONDITION
(C) CHECKING THE SPARK PLUG GAP

(2) CLEANING THE SPARK PLUGS, IF THIS IS DEEMED DESIRABLE
(3) SELECTING SPARK PLUG REPLACEMENTS AND TYPES OF SPARK PLUGS
(4) ADJUSTING SPARK PLUG GAP
(5) INSTALLING SPARK PLUGS

B. INSPECTING AND SERVICING SPARK PLUG WIRES

(1) CHECKING TO DETERMINE IF SPARK IS COMING THROUGH
(2) REMOVING THE WIRES, IF NECESSARY
(3) CHECKING THE METAL CONNECTORS ON THE SPARK PLUG WIRES
(4) CUTTING NEW PLUG WIRES, IF NECESSARY, AND INSTALLING THE CONNECTORS
(5) INSTALLING THE NEW WIRES IN THE PROPER ORDER

C. INSPECTING AND SERVICING THE DISTRIBUTOR AND POINTS

(1) CHECKING THE TIMING TO DETERMINE IF IT IS CORRECT
(2) REMOVING AND INSPECTING THE CAP AND ROTOR
(3) CHECKING THE CONDITION OF THE BREAKER POINTS AND CONDENSOR AND THE BREAKER CAM
(4) REMOVING THE POINTS AND CONDENSOR AND TESTING THE IGNITION CONDENSOR
(5) REPLACING AND INSTALLING THE POINTS AND CONDENSOR
(6) ADJUSTING THE BREAKER POINT GAP
(7) REPLACING AND INSTALLING THE ROTOR AND DISTRIBUTOR CAP
(8) TIMING THE DISTRIBUTOR

D. INSPECTING AND SERVICING MAGNETO IGNITION ENGINES

(1) REMOVING THE MAGNETO
(2) INSTALLING THE MAGNETO
(3) TIMING AN ENGINE WITH MAGNETO IGNITION

E. INSPECTING AND SERVICING THE COIL

(1) CHECKING TO DETERMINE IF AN ELECTRICAL CURRENT IS COMING FROM THE COIL INTO THE DISTRIBUTOR
(2) CHECKING FOR BROKEN LEADS, LOOSE CONNECTIONS OR CRACKS
(3) REMOVING AND TESTING THE COIL
(4) REPLACING AND INSTALLING THE COIL

F. INSPECTING AND SERVICING THE BATTERY

(1) VISUALLY INSPECTING THE BATTERY

    (A) CHECKING THE ELECTROLYTE LEVEL IN THE CELLS
    (B) CHECKING FOR LOOSE TERMINAL CONNECTIONS OR CORRODED TERMINALS
    (C) INSPECTING FOR A CRACKED OR LEAKING CASE

(2) MEASURING SPECIFIC GRAVITY OF BATTERY TO DETERMINE THE CHARGE
(3) CHECKING CELL VOLTAGE WITH A VOLT METER
(4) ADDING WATER TO THE BATTERY
(5) CLEANING THE TERMINALS, REPLACING BATTERY CABLES, IF NEEDED, AND CONNECTING THE CABLES TO THE TERMINALS
(6) CHARGING A BATTERY
(7) INSTALLING A NEW BATTERY

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE AND LIST THE SYMPTOMS THEY OBSERVED ON AN ENGINE WHICH HAD MALADJUSTMENTS IN THE IGNITION SYSTEM. AFTER THE OBSERVED SYMPTOMS HAVE BEEN LISTED, HAVE THE STUDENTS REFER TO A SERVICE MANUAL TO IDENTIFY POSSIBLE DEFECTS IN THE IGNITION SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE OBSERVED SYMPTOMS.

2. A. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS PULL THE SPARK PLUGS AND CHECK THE CONDITION OF THE PLUGS AND THE PLUG GAP. AFTER THE STUDENTS HAVE CHECKED THE CONDITION OF THE PLUGS, THEY SHOULD DECIDE WHETHER THE PLUGS NEED TO BE REPLACED WITH NEW PLUGS.

   B. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS CHECK THE COIL WITH A TEST LAMP AND PROBES FOR GROUNDED WINDINGS.

   C. HAVE THE STUDENTS PULL THE DISTRIBUTOR CAP FROM THE ENGINES THEY ARE WORKING ON AND INSPECT THE CONDITION OF THE CAP AND ROTOR AND CHECK THE BREAKER POINT GAP.

3. A. HAVE THE STUDENTS INSTALL NEW PLUGS IN THE ENGINES THEY ARE WORKING ON IN THE SHOP, BEING SURE THAT THE CORRECT TYPE OF PLUG IS INSTALLED AND THAT THE PLUG GAP IS SET ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

   B. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS TIME THE DISTRIBUTOR TO THE ENGINE BY USING AN ELECTRIC TIMING LIGHT.

   C. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS REPLACE THE SPARK PLUG WIRES BY CUTTING WIRES TO THE PROPER LENGTH, INSTALLING THE CONNECTORS AND REPLACING THE WIRES, BEING SURE THEY ARE INSTALLED ACCORDING TO THE FIRING ORDER.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A CASE STUDY WHICH DESCRIBES SYMPTOMS THAT WERE OBSERVED WHEN AN ENGINE WAS OPERATING. FOR EACH SYMPTOM THAT WAS OBSERVED, HAVE THE STUDENTS LIST ONE POTENTIAL DEFECT IN THE IGNITION SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOM. FOR EACH POTENTIAL DEFECT THEY LIST, HAVE THE STUDENTS LIST OR DESCRIBE THE PROCEDURES THEY WOULD FOLLOW TO DETERMINE IF THAT DEFECT WAS INDEED CAUSING OR CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOM.

2. A. USING SEVERAL SPARK PLUGS WHICH SHOW EVIDENCE OF THE VARIOUS TYPES OF FOULING, HAVE THE STUDENTS SELECT FROM A LIST THE CORRECT NAME FOR THE FOULING PROBLEM AND THEN DESCRIBE THE CAUSE OF THE FOULED PLUG.

   B. HAVE THE STUDENT DESCRIBE THE PROCEDURES HE WOULD FOLLOW IN MAKING A PRELIMINARY CHECK TO DETERMINE IF AN ELECTRICAL CURRENT IS PASSING FROM THE COIL TO THE DISTRIBUTOR.

   C. HAVE THE STUDENT LIST WHAT DEFECTS HE WOULD LOOK FOR WHEN INSPECTING THE DISTRIBUTOR CAP. THIS LIST SHOULD INCLUDE ITEMS SUCH AS CARBON PATHS, CRACKS OR CHIPS, ERODED SPARK PLUG CONTACTS AND WORN CENTER TERMINAL BUTTON.

3. A. DEVELOP A SKETCH WHICH SHOWS THE ARRANGEMENT OF THE SPARK PLUGS IN THE ENGINE, A DISTRIBUTOR CAP WITH NUMBER ONE WIRE TERMINAL LABELED, THE DIRECTION OF THE ROTOR INDICATED, AND THE FIRING ORDER INDICATED. HAVE THE STUDENTS LABEL THE SPARK PLUGS ACCORDING TO THE CYLINDER NUMBER THEY REPRESENT AND DRAW THE WIRE CONNECTIONS BETWEEN THE DISTRIBUTOR AND THE SPARK PLUGS ACCORDING TO THE FIRING ORDER PROVIDED.

   B. HAVE THE STUDENTS ADJUST THE SPARK PLUG GAP ON A SPARK PLUG WITH COMPLETE ACCURACY ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

   C. HAVE THE STUDENTS TIME THE DISTRIBUTOR TO THE ENGINE, ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS BY USING A TIMING LIGHT.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. ENGINES FOR THE STUDENTS TO WORK ON

2. EXAMPLES OF SPARK PLUGS, IGNITION WIRES, BREAKER POINTS, AND CONDENSORS FOR THE STUDENTS TO INSPECT AND TEST, IF NECESSARY, FOR DEFECTS

3. CHARTS WHICH SHOW THE VARIOUS COMPONENTS OF THE IGNITION SYSTEM

4. APPROPRIATE SMALL HAND TOOLS SUCH AS WRENCHES, PLIERS, SCREWDRIVERS, FEELER GAUGE, SPARK PLUG GAUGE, WIRE CUTTERS, WIRE CRIMPING TOOL, AND SOCKET SETS WITH 13/16" DEEP SPARK PLUG SOCKET

5. SPECIAL TESTING EQUIPMENT FOR THE IGNITION SYSTEM SUCH AS A TIMING LIGHT, HYDROMETER, BATTERY CHARGER, VOLT METER, TEST LAMP WITH PROBES AND METER-TYPE COIL AND CONDENSOR TESTER

F. EXAMPLES OF SUPPORTING REFERENCES

1. FARM TRACTOR TUNE-UP. VAS 3008. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1958, 12 PAGES.

   THIS MAY BE ESPECIALLY HELPFUL AS A STUDENT REFERENCE. TOPICS COVERED IN THIS REFERENCE INCLUDE CHECKING THE IGNITION SPARK, INSTALLING AND GAPPING DISTRIBUTOR POINTS, MAGNETO POINTS, TIMING THE DISTRIBUTOR, TIMING THE MAGNETO, AND TESTING THE BATTERY. MOST OF THESE SECTIONS INCLUDE A BRIEF "HOW-TO-DO" COMPONENT THAT CAN BE READILY UNDERSTOOD BY THE PUPIL.

2. FUNDAMENTALS OF SERVICE: ELECTRICAL SYSTEMS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, 226 PAGES.

   A VERY COMPREHENSIVE REFERENCE, THIS PUBLICATION DESCRIBES AND ILLUSTRATES ALL CIRCUITS IN THE ELECTRICAL SYSTEM. INCLUDED IN THIS REFERENCE WHICH THE TEACHER MAY FIND ESPECIALLY HELPFUL IS A SECTION ON DIAGNOSING AND TESTING OF ELECTRICAL SYSTEMS AND A SECTION ON THE USE OF TESTING TOOLS AND EQUIPMENT.

3. THE IGNITION CIRCUIT AND HOW IT WORKS. ANDERSON, INDIANA: DELCO-REMY. 20 PAGES.

   A WELL ILLUSTRATED PUBLICATION WHICH IS EASY FOR STUDENTS TO UNDERSTAND, IT COVERS SUCH AREAS AS THE FUNCTION OF THE VARIOUS COMPONENTS OF THE IGNITION CIRCUIT.

4. THE IGNITION SYSTEM - TESTING AND ANALYZING TEST RESULTS. VAS 3028. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1967, 28 PAGES.

   AN EXCELLENT REFERENCE FOR STUDENT USE. IT EXPLAINS AND ILLUSTRATES WHAT TESTS SHOULD BE MADE ON THE VARIOUS PARTS OF THE IGNITION SYSTEM AND HOW TO INTERPRET THE RESULTS OF THE TESTS.

5. INDIVIDUAL STUDY GUIDE ON ELECTRICAL SYSTEMS FOR SPARK-IGNITION ENGINES. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1970, 212 PAGES.

A STUDENT STUDY GUIDE, THIS PUBLICATION INCLUDES APPROPRIATE STUDENT LEARNING ACTIVITIES FOR VARIOUS COMPONENTS OF THE ELECTRICAL SYSTEM.

6. SERVICE MANUALS FOR THE ENGINE BEING WORKED ON

   THESE WILL PROVIDE NEEDED TECHNICAL INFORMATION AND PROCEDURES TO FOLLOW IN WORKING WITH THE VARIOUS COMPONENTS OF THE IGNITION SYSTEM.

7. THE TRACTOR ELECTRICAL SYSTEM. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS. 1971, 64 PAGES.

   THIS REFERENCE IS ESPECIALLY HELPFUL TO THE TEACHER IN PROVIDING BACKGROUND INFORMATION FOR THE IGNITION CIRCUIT. INCLUDED IS A SECTION ON THE FUNDAMENTALS OF ELECTRICITY WHICH MAY BE HELPFUL TO THE TEACHER BUT MAY BE MORE DETAILED THAN IS NEEDED FOR HIGH SCHOOL STUDENTS.

THE COOLING SYSTEM

UNIT CONCEPT: THE SERVICE AND REPAIR OF THE COOLING SYSTEM ON THE INTERNAL COMBUSTION ENGINE WILL AID IN REGULATING THE TEMPERATURE IN THE ENGINE AND IN PREVENTING EXCESSIVELY HIGH TEMPERATURES AROUND THE ENGINE PARTS. THIS WILL RESULT IN MINIMIZING SUCH PROBLEMS AS PRE-IGNITION, DETONATION, ENGINE KNOCK, LUBRICATION FAILURE, ENGINE WEAR AND POOR FUEL ECONOMY.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH AN ENGINE WITH DEFECTS IN THE COOLING SYSTEM, DIAGNOSE THE NATURE OF THE DEFECTS BY FOLLOWING APPROPRIATE TROUBLESHOOTING PROCEDURES.

2. WHEN PROVIDED WITH A WATER COOLED ENGINE, CLEAN THE COOLING SYSTEM OR CHECK THE ANTIFREEZE SOLUTION AND ADD WATER AND ANTIFREEZE TO THE RADIATOR.

3. WHEN PROVIDED WITH A WATER COOLED ENGINE WITH DEFECTS IN THE FOOLING SYSTEM, REMOVE, DISASSEMBLE WHEN NECESSARY AND/OR INSPECT THE FOLLOWING PARTS OF THE COOLING SYSTEM:

   A. FAN BELT AND FAN
   B. RADIATOR HOSES
   C. THERMOSTAT
   D. RADIATOR
   E. WATER PUMP
   F. WATER FILTER

4. WHEN PROVIDED WITH AN ENGINE IN WHICH DEFECTS IN THE COOLING SYSTEM HAVE BEEN IDENTIFIED, REPLACE, REASSEMBLE WHEN NECESSARY, INSTALL, AND/OR ADJUST THE FOLLOWING PARTS OF THE COOLING SYSTEM:

   A. FAN BELT AND FAN
   B. RADIATOR HOSES
   C. THERMOSTAT
   D. RADIATOR
   E. WATER PUMP
   F. WATER FILTER

B. INSTRUCTIONAL AREAS

1. DIAGNOSING THE NATURE OF THE PROBLEMS IN THE COOLING SYSTEM

A. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE WATER COOLING SYSTEM SUCH AS:

(1) PRE-IGNITION
(2) DETONATION
(3) ENGINE KNOCK
(4) ENGINE WEAR
(5) POOR FUEL ECONOMY

B. COMPONENTS OF THE WATER COOLING SYSTEM

(1) IDENTIFYING THE PARTS OF THE SYSTEM
(2) DETERMINING THE PURPOSE OF THE PARTS OF THE COOLING SYSTEM
(3) DETERMINING THE FUNCTION OF ANTIFREEZE COOLANTS

C. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS WITH THE COOLING SYSTEM

D. GENERAL PROCEDURES TO USE IN TROUBLESHOOTING THE WATER COOLING SYSTEM FOR DEFECTS

2. CLEANING THE COOLING SYSTEM AND CHECKING THE ANTIFREEZE LEVEL

A. CHECKING THE WATER LEVEL AND ADDING WATER OR OTHER LIQUIDS

B. DRAINING, CLEANING, AND FLUSHING THE COOLING SYSTEM WHEN NECESSARY

C. CHECKING THE ANTIFREEZE PROTECTION LEVEL IN THE COOLING SYSTEM

D. DETERMINING THE AMOUNT OF ANTIFREEZE TO ADD AND ADDING THE ANTIFREEZE

3. INSPECTING VARIOUS PARTS OF THE COOLING SYSTEM FOR DEFECTS AND REMOVING THE DEFECTIVE PARTS

A. INSPECTING THE WATER FILTER ON ENGINES EQUIPPED WITH A FILTER

(1) DRAINING THE SEDIMENT FROM THE COOLANT FILTER
(2) REMOVING THE FILTER ELEMENT

B. INSPECTING THE FAN AND FAN BELT

(1) CHECKING FOR A FRAYED OR LOOSE FAN BELT AND REMOVING THE BELT WHEN NECESSARY
(2) CHECKING FOR A DAMAGED FAN

C. INSPECTING THE RADIATOR HOSES

(1) CHECKING THE OUTSIDE SURFACES OF RADIATOR HOSES FOR DEFECTS
(2) REMOVING THE RADIATOR HOSES AND CHECKING THE INTERIOR SURFACES OF THE RADIATOR HOSES

D. INSPECTING THE THERMOSTAT

(1) REMOVING THE THERMOSTAT AND INSPECTING FOR BREAKS AND CORROSION
(2) TESTING THE THERMOSTAT FOR OPENING AND CLOSING ACTION

E. INSPECTING THE RADIATOR FOR LEAKS

(1) INSPECTING AND TESTING THE RADIATOR FOR LEAKS
(2) REMOVING THE RADIATOR IF REPAIRS ARE NEEDED

F. INSPECTING THE WATER PUMP

(1) CHECKING THE WATER PUMP FOR LEAKS DUE TO BAD SEALS, A DAMAGED GASKET AND CRACKED HOUSING
(2) REMOVING THE WATER PUMP

4. CORRECTING THE PROBLEMS THAT HAVE BEEN DETECTED IN VARIOUS PARTS OF THE COOLING SYSTEM

A. CORRECTING DEFECTS IN THE WATER PUMP

(1) REPLACING THE WATER PUMP
(2) INSTALLING THE WATER PUMP

B. CORRECTING THE DEFECTS IN THE RADIATOR

(1) STRAIGHTENING BENT RADIATOR FINS AND REMOVING DEBRIS
(2) INSTALLING A REPAIRED RADIATOR WHEN NECESSARY

C. CORRECTING THE DEFECTS IN THE THERMOSTAT

(1) REPLACING THE THERMOSTAT WHEN NECESSARY
(2) INSTALLING THE THERMOSTAT

D. CORRECTING THE DEFECTS IN THE RADIATOR HOSE

(1) REPLACING THE DAMAGED HOSES
(2) INSTALLING THE RADIATOR HOSES

E. CORRECTING THE DEFECTS IN THE FAN BELT

(1) REPLACING A DAMAGED FAN

(2) REPLACING A FRAYED FAN BELT
(3) ADJUSTING THE FAN BELT TENSION

F. CORRECTING THE DEFECTS IN THE COOLANT FILTER

(1) INSTALLING A NEW FILTER ELEMENT

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING AN ENGINE WITH DEFECTS IN THE LIQUID COOLING SYSTEM, HAVE THE STUDENTS OBSERVE THE ENGINE WHILE IT IS OPERATING FOR SYMPTOMS AND THEN USE A SERVICE MANUAL TO IDENTIFY POSSIBLE DEFECTS IN THE COOLING SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. USING THE RADIATOR FROM THE ENGINES ON WHICH THE STUDENTS ARE WORKING, THE SERVICE MANUAL AND A TABLE THAT MAY BE FOUND ON THE BACK OF ANTIFREEZE CONTAINERS, HAVE THE STUDENTS CALCULATE THE AMOUNT OF ANTIFREEZE THEY WOULD NEED TO ADD TO THE ENGINE COOLING SYSTEM IN ORDER TO PROVIDE PROTECTION AT A SPECIFIED TEMPERATURE.

3. USING THE THERMOSTATS FROM THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS TEST THE THERMOSTATS TO DETERMINE IF THEY ARE BEGINNING TO OPEN AT THE PROPER TIME AND OBSERVE THE CLOSING ACTION OF THE THERMOSTAT. THE TEACHER WILL NEED TO PROVIDE CONTAINERS, THERMOMETERS AND A MEANS FOR SUSPENDING THE THERMOSTATS IN THE CONTAINERS OR A COMMERCIAL THERMOSTAT TESTER.

4. USING THE RADIATOR HOSES THAT THE STUDENTS ARE INSTALLING ON THEIR ENGINES, HAVE THE STUDENTS INSTALL THE HOSES ON THEIR ENGINES BEING SURE TO CLEAN THE PIPE CONNECTIONS, APPLYING A SEALING COMPOUND, AND TIGHTENING THE RADIATOR HOSE CLAMPS.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP AN OBJECTIVE TYPE OF EXERCISE FOR THE STUDENTS TO COMPLETE. USING A CASE-TYPE OF SITUATION, DESCRIBE FOR THE STUDENTS THE SYMPTOM(S) THAT WERE OBSERVED WHEN AN ENGINE WAS OPERATING. HAVE THE STUDENTS INDICATE WHAT POTENTIAL DEFECTS IN THE COOLING SYSTEM MIGHT RESULT IN THE APPEARANCE OF THE SYMPTOM(S) OBSERVED.

2. HAVE THE STUDENTS DRAIN, CLEAN, AND FLUSH THE COOLING SYSTEM ON AN INTERNAL COMBUSTION ENGINE. EVALUATE THE STUDENTS BY CONSIDERING WHETHER APPROPRIATE PROCEDURES WERE FOLLOWED.

3. USING A THERMOSTAT AND A MEANS FOR TESTING THE THERMOSTAT, WHETHER IT BE A COMMERCIAL TESTER OR A CONTAINER AND A THERMOMETER, HAVE EACH STUDENT TEST THE THERMOSTAT AND DETERMINE IF IT IS OPENING AND CLOSING AT THE PROPER TEMPERATURE. HAVE EACH STUDENT INDICATE WHETHER THE THERMOSTAT SHOULD BE REPLACED OR WHETHER IT DOES NOT NEED TO BE REPLACED.

4. USING THE ENGINE ON WHICH THE STUDENTS ARE WORKING, HAVE EACH STUDENT ADJUST THE FAN BELT. THERE SHOULD BE APPROXIMATELY A 1/2" DEFLECTION IN THE BELT UNLESS OTHER SPECIFICATIONS ARE PROVIDED IN THE SERVICE MANUAL.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. VARIOUS TYPES OF THERMOSTATS FOR THE STUDENTS TO INSPECT AND TEST.

2. VARIOUS TYPES OF WATER PUMPS FOR THE STUDENTS TO INSPECT.

3. HAND TOOLS NECESSARY FOR INSPECTING, REPAIRING AND ADJUSTING THE COMPONENTS OF THE COOLING SYSTEM INCLUDING A THERMOMETER, A RADIATOR AND CAP PRESSURE TESTER AND A COMMERCIAL OR HOMEMADE THERMOSTAT TESTER, SMALL WRENCHES, SCREWDRIVERS, PLIERS, AND WATER CAN

4. ENGINES FOR THE STUDENTS TO WORK ON

5. FAN BELTS, RADIATOR HOSES, AND COOLANT FILTERS THAT SHOW DEFECTS IN THESE PARTS

6. SEALING COMPOUND FOR RADIATOR HOSES

7. ANTIFREEZE AND TESTERS

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATION. 1972, PP. 8-1 - 8-16.

   INCLUDED IN THIS PUBLICATION ARE THE PROPER PROCEDURES FOR TESTING THE RADIATOR AND RADIATOR CAP, THE WATER PUMP AND THERMOSTATS. PROPER PROCEDURES FOR REPLACING WATER HOSES AND CLEANING THE COOLING SYSTEM ARE ALSO INCLUDED.

2. SERVICE MANUALS FOR THE ENGINES BEING WORKED ON.

   THESE WILL INCLUDE TECHNICAL INFORMATION AND PROCEDURES TO FOLLOW IN REPAIRING, SERVICING AND INSTALLING VARIOUS COMPONENTS OF THE COOLING SYSTEM.

3. TRACTOR MAINTENANCE: PRINCIPLES AND PROCEDURES. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS. 1970, PP. 119-128.

THIS PUBLICATION PRESENTS A GENERAL MAINTENANCE PROGRAM FOR THE COOLING SYSTEM INCLUDING PROCEDURES TO FOLLOW AND MATERIALS TO USE IN CLEANING THE COOLING SYSTEM.

THE GOVERNOR SYSTEM ON SPARK IGNITION ENGINES

UNIT CONCEPT: THE GOVERNOR IS USED ON EQUIPMENT TO AUTOMATICALLY CONTROL THE SPEEDS OF AN ENGINE UNDER VARYING LOADS. SERVICING THE GOVERNOR SYSTEM WILL AID IN MINIMIZING ENGINE PROBLEMS SUCH AS ERRATIC ENGINE OPERATION, HUNTING OR MISSING, ERRATIC ENGINE IDLE, OR THE ENGINE NOT DEVELOPING FULL POWER.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. GIVEN SPARK IGNITION ENGINES WITH MALFUNCTIONS IN THE GOVERNOR SYSTEM, DIAGNOSE THE NATURE OF THE MALFUNCTION BY FOLLOWING PROCEDURES DETAILED IN THE SERVICE MANUAL.
2. PROVIDED AN ENGINE ON WHICH MALADJUSTMENTS HAVE BEEN IDENTIFIED IN THE GOVERNOR SYSTEM, ADJUST THE GOVERNOR SCREW OR REPLACE THE GOVERNOR SPRING.
3. PROVIDED AN ENGINE ON WHICH DEFECTS HAVE BEEN IDENTIFIED IN THE GOVERNOR ASSEMBLY, REMOVE THE GOVERNOR ASSEMBLY, CLEAN THE COMPONENTS, REPLACE COMPONENTS IF NECESSARY, REASSEMBLE, AND INSTALL THE GOVERNOR ASSEMBLY ACCORDING TO DIRECTIONS PROVIDED IN THE SERVICE MANUAL.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND/OR PROBLEMS CAUSED BY DEFECTS OR MALADJUSTMENTS IN THE GOVERNING SYSTEM SUCH AS:
    - A. ENGINE SURGES OR HUNTING
    - B. ERRATIC ENGINE IDLE
2. COMPONENTS OF THE GOVERNOR SYSTEM
    - A. IDENTIFYING THE PARTS OF THE SYSTEM
    - B. DETERMINING THE FUNCTION OF THE PARTS
    - C. TYPES OF GOVERNORS
3. DETERMINING THE MAJOR CAUSES OF PROBLEMS IN THE GOVERNING SYSTEM

4. DIAGNOSING THE NATURE OF SPECIFIC DEFECTS IN THE GOVERNING SYSTEM

5. INSPECTING AND SERVICING THE GOVERNORING SYSTEM

   A. GENERAL MAINTENANCE PROCEDURES

      (1) INSPECTING THE GOVERNOR SPRING
      (2) REPLACING THE GOVERNOR SPRING
      (3) ADJUSTING THE GOVERNOR ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS
      (4) REMOVING DEBRIS FROM THE EXTERNAL PARTS OF THE GOVERNOR ASSEMBLY

   B. INSPECTING AND SERVICING THE INTERNAL COMPONENTS OF THE GOVERNOR

      (1) REMOVING THE GOVERNOR ASSEMBLY
      (2) DISASSEMBLING THE GOVERNOR ASSEMBLY
      (3) INSPECTING THE COMPONENT PARTS OF THE GOVERNOR ASSEMBLY FOR CRACKS AND FREEDOM OF MOVEMENT
      (4) CLEANING THE PARTS OF THE GOVERNOR TO INSURE FREEDOM OF MOVEMENT
      (5) REASSEMBLING THE PARTS OF THE GOVERNOR ASSEMBLY
      (6) INSTALLING THE GOVERNOR IN THE ENGINE

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE AN OPERATING ENGINE THAT HAS A MALFUNCTIONING GOVERNOR ASSEMBLY. AFTER THE OBSERVED SYMPTOMS HAVE BEEN LISTED, HAVE THE STUDENTS USE SERVICE MANUALS TO IDENTIFY POTENTIAL DEFECTS.

2. USING ENGINES WITH MALADJUSTMENTS IN THE GOVERNING SYSTEMS, HAVE THE STUDENTS ADJUST THE GOVERNOR SETTING BY TURNING THE GOVERNOR ADJUSTING SCREW.

3. USING ENGINES WITH GOVERNOR SYSTEMS, HAVE THE STUDENTS REMOVE THE GOVERNOR ASSEMBLY AND CLEAN THE WEIGHTS AND THRUST BEARING IN COMMERCIAL SOLVENT TO INSURE FREE MOVEMENT OF THE WEIGHTS WHEN THE ENGINE IS OPERATING.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN THE SYMPTOMS THAT WERE OBSERVED AND THE SECOND COLUMN SHOULD CONTAIN THE POTENTIAL DEFECTS IN THE GOVERNOR SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. HAVE THE STUDENTS ADJUST THE GOVERNOR AND THROTTLE CONTROL LINKAGE ON AN ENGINE USING A SERVICE MANUAL FOR DIRECTIONS. EVALUATE THE STUDENT ACCORDING TO THE SPECIFICATIONS IN THE SERVICE MANUAL.

3. HAVE THE STUDENTS CLEAN THE THRUST BEARING AND WEIGHTS ON THE GOVERNOR IN A COMMERCIAL SOLVENT. AFTER THE GOVERNOR IS REASSEMBLED, EVALUATE THE STUDENTS BY CONSIDERING THE FREEDOM OF MOVEMENT OF THE WEIGHTS AND THRUST BEARING AND FREEDOM FROM DEBRIS.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. ENGINES FOR THE STUDENTS TO WORK ON
2. CHARTS SHOWING THE VARIOUS TYPES OF GOVERNING SYSTEMS USED
3. APPROPRIATE SMALL HAND TOOLS SUCH AS WRENCHES, SCREWDRIVERS, PLIERS, AND HAMMER
4. COMMERCIAL CLEANING SOLVENT, OIL, AND COTTER PINS

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATION. 1972, PP. 9-1 - 9-9.

   THIS PUBLICATION PRESENTS THE FUNCTION OF THE GOVERNING SYSTEM AND THE OPERATION OF GOVERNING SYSTEMS IN A MANNER THAT STUDENTS WILL FIND EASY TO UNDERSTAND. A BRIEF SECTION COMPARES THE GOVERNING SYSTEM ON GASOLINE AND LP-GAS ENGINES WITH THE GOVERNING SYSTEM ON DIESEL ENGINES. A TROUBLESHOOTING CHART IS PROVIDED AT THE END OF THE CHAPTER.

2. SERVICE MANUALS FOR THE ENGINES BEING WORKED ON

   THESE WILL INCLUDE PROCEDURES FOR ADJUSTING THE GOVERNOR AND THROTTLE LINKAGE, REMOVING THE GOVERNOR AND INSTALLING THE GOVERNOR.

THE GASOLINE FUEL SYSTEM

UNIT CONCEPT: REPAIRING AND SERVICING THE VARIOUS COMPONENTS OF THE GASOLINE FUEL SYSTEM WHICH ARE RESPONSIBLE FOR SUPPLYING A COMBUSTIBLE MIXTURE OF FUEL AND AIR TO POWER THE ENGINE, WILL RESULT IN MINIMIZING OR ELIMINATING ENGINE PROBLEMS SUCH AS A LACK OF POWER, ENGINE BACKFIRING, EXCESSIVE USE OF FUEL, DIFFICULTY IN STARTING OR THE ENGINE RUNNING IRREGULARLY.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH AN ENGINE WITH DEFECTS IN THE GASOLINE FUEL SYSTEM, OBSERVE THE SYMPTOMS WHICH MAY INDICATE DEFECTS IN THE GASOLINE FUEL SYSTEM AND DIAGNOSE THE NATURE OF THE DEFECTS OR MALADJUSTMENTS BY FOLLOWING APPROPRIATE TROUBLESHOOTING PROCEDURES.

2. WHEN PROVIDED WITH EQUIPMENT WITH SYMPTOMS THAT MAY INDICATE DEFECTS IN THE GASOLINE FUEL SYSTEM, REMOVE, DISASSEMBLE WHEN NECESSARY, AND/OR INSPECT BY FOLLOWING THE PROCEDURES IN A SERVICE MANUAL THE FOLLOWING COMPONENTS OF THE GASOLINE FUEL SYSTEM:

   A. FUEL TANK

   B. FUEL LINES

   C. AIR CLEANER

   D. FUEL FILTER

   E. CARBURETOR

   F. FUEL PUMP

3. WHEN PROVIDED WITH EQUIPMENT ON WHICH THE DEFECTS IN THE GASOLINE FUEL SYSTEM HAVE BEEN IDENTIFIED, REPLACE, REASSEMBLE WHEN NECESSARY, INSTALL, AND ADJUST ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS:

   A. FUEL TANK

   B. FUEL PUMP

   C. AIR CLEANER

   D. FUEL FILTER

   E. CARBURETOR

   F. FUEL PUMP

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE GASOLINE FUEL SYSTEM SUCH AS:

   A. LACK OF POWER

   B. ENGINE MISFIRING

   C. EXCESSIVE USE OF FUEL

   D. DIFFICULTY IN STARTING

   E. ENGINE RUNNING IRREGULARLY AND SURGING

2. COMPONENTS AND PRINCIPLES OF THE GASOLINE FUEL SYSTEM

   A. IDENTIFYING THE PARTS OF THE SYSTEM

   B. DETERMINING THE FUNCTION OF THE VARIOUS COMPONENTS

   C. DETERMINING THE PRINCIPLES OF CARBURETION

3. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE GASOLINE FUEL SYSTEM

4. GENERAL TROUBLESHOOTING PROCEDURES USED FOR THE GASOLINE FUEL SYSTEM TO HELP LOCATE SPECIFIC PROBLEMS WITHIN THE VARIOUS COMPONENTS OF THE GASOLINE FUEL SYSTEM

5. INSPECTING AND SERVICING SPECIFIC COMPONENTS OF THE GASOLINE FUEL SYSTEM

   A. INSPECTING AND REPAIRING THE GASOLINE FUEL TANK

      (1) INSPECTING THE FUEL TANK FOR LEAKS
      (2) REMOVING THE TANK WHEN NECESSARY
      (3) PROCEDURES AND SAFETY PRACTICES TO FOLLOW IN REPAIRING THE FUEL TANK
      (4) INSTALLING THE FUEL TANK

   B. INSPECTING AND REPLACING FUEL LINES

      (1) INSPECTING FOR LEAKS ALONG THE LINE AND AT THE VARIOUS CONNECTIONS

(2) REMOVING THE LINES WHEN DEEMED NECESSARY
(3) REPLACING THE FUEL LINES WHEN NECESSARY

C. INSPECTING AND SERVICING THE FUEL PUMP AND FUEL FILTER

(1) INSPECTING THE SEDIMENT BOWL BY REMOVING THE BOWL, SCREEN AND GASKET AND CLEANING THE SCREEN AND BOWL
(2) REMOVING A FUEL PUMP WHICH HAS BEEN DETERMINED TO BE DEFECTIVE
(3) INSTALLING A NEW OR REBUILT FUEL PUMP

D. INSPECTING AND SERVICING THE AIR CLEANER

(1) REMOVING THE CARBURETOR WHEN NECESSARY
(2) DISASSEMBLING THE CARBURETOR

(A) CLEANING THE PARTS OF THE CARBURETOR
(B) VISUALLY INSPECTING THE VARIOUS PARTS
(C) MEASURING FLOAT ADJUSTMENT AND CHECKING FOR CARBURETOR WARPAGE

(3) INSTALLING CARBURETOR REPAIR KITS
(4) REASSEMBLING THE CARBURETOR AND MAKING INITIAL CARBURETOR ADJUSTMENTS
(5) INSTALLING THE CARBURETOR
(6) PROCEDURES TO FOLLOW IN MAKING FINAL ADJUSTMENTS ON THE CARBURETOR

(A) IDLE SPEED ADJUSTMENT
(B) IDLE FUEL ADJUSTMENT
(C) FULL-LOAD FUEL ADJUSTMENT

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE AN ENGINE ON WHICH THERE ARE SYMPTOMS EVIDENT WHICH MAY INDICATE DEFECTS IN THE VARIOUS COMPONENTS OF THE GASOLINE FUEL SYSTEM. AFTER THE SYMPTOMS HAVE BEEN OBSERVED, HAVE THE STUDENTS USE A SERVICE MANUAL OR A MANUAL SUCH AS FUNDAMENTALS OF SERVICE: ENGINES, MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATION, 1972, TO IDENTIFY POTENTIAL DEFECTS IN THE CARBURETION SYSTEM THAT MAY BE CONTRIBUTING TO EACH SYMPTOM OBSERVED.

2. A. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE EACH STUDENT REMOVE THE SEDIMENT BOWL AND SCREEN AND CLEAN THEM IN A COMMERCIAL SOLVENT AND BLOW OUT THE DIRT FROM THE SCREEN WITH AIR.

B. HAVE EACH STUDENT REMOVE THE CARBURETOR FROM THE ENGINE ON WHICH HE IS WORKING. THE STUDENT SHOULD DISASSEMBLE THE CARBURETOR, CLEAN THE VARIOUS PARTS OF THE CARBURETOR, AND INSPECT THE VARIOUS NEEDLES AND SEATS FOR DEFECTS.

3. A. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS REPLACE THE AIR CLEANER ELEMENT OR ADD NEW OIL TO THE OIL BATH TYPE AIR CLEANER WHEN THE ENGINE IS EQUIPPED WITH SUCH AN AIR CLEANER.

B. USING THE CARBURETORS FROM THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS REASSEMBLE THE CARBURETOR, INCLUDING INSTALLING A CARBURETOR KIT WHEN NECESSARY, MAKING THE INITIAL CARBURETOR ADJUSTMENTS ACCORDING TO THE SERVICE MANUAL, AND INSTALLING THE CARBURETOR ON THE ENGINE.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP AN "AGREE AND DISAGREE" EXERCISE FOR THE STUDENTS TO COMPLETE. DEVELOP A SERIES OF STATEMENTS WHICH DESCRIBE THE SYMPTOMS OBSERVED AND THE POSSIBLE DEFECT(S). HAVE THE STUDENTS REACT TO EACH STATEMENT BY AGREEING OR DISAGREEING WITH THE POSSIBLE DEFECT IN THE GASOLINE FUEL SYSTEM FOR THE OBSERVED SYMPTOM. IN THOSE CASES WHERE THE STUDENTS DISAGREE, HAVE THEM INDICATE WHAT THEY WOULD BELIEVE TO BE A DEFECT IN THE FUEL SYSTEM THAT MAY BE CONTRIBUTING TO THE SYMPTOM.

2. A. USING FLOAT-TYPE CARBURETORS, HAVE THE STUDENTS MEASURE THE CARBURETOR FLOAT LEVEL AND DETERMINE WHETHER IT IS ADJUSTED ACCORDING TO THE SERVICE MANUAL SPECIFICATIONS.

B. USING A DISPLAY WHICH HAS SEVERAL CARBURETOR NEEDLES, SOME BEING DEFECTIVE AND SOME NOT, HAVE THE STUDENTS INSPECT AND IDENTIFY THE NEEDLES WHICH ARE DEFECTIVE AND NEED TO BE REPLACED.

3. A. USING A SKETCH OF THE CROSS SECTION OF A CARBURETOR, HAVE THE STUDENTS LABEL THE VARIOUS ADJUSTMENT NEEDLES WHICH THE TEACHER HAS CIRCLED; THEN USE A SERVICE MANUAL TO LOCATE AND WRITE DOWN THE INITIAL ADJUSTMENT FOR THE LOAD ADJUSTING NEEDLE, IDLE ADJUSTING NEEDLE AND THROTTLE LEVER ADJUSTING NEEDLE.

B. HAVE THE STUDENT LIST THE PROCEDURES HE WOULD FOLLOW IN MAKING FINAL CARBURETOR ADJUSTMENTS. THE STUDENT SHOULD INDICATE ANY SPECIAL TOOLS OR EQUIPMENT HE WOULD USE.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. ADJUSTING NEEDLES AND SEATS FROM CARBURETORS FOR THE STUDENTS TO INSPECT WHICH SHOW TYPES OF DAMAGE FOUND ON NEEDLES AND SEATS

2. AIR CLEANER ELEMENTS USED ON ENGINES

3. ENGINES AND CARBURETORS FOR THE STUDENTS TO WORK ON

4. CHARTS WHICH SHOW THE FLOW OF AIR AND FUEL IN THE GASOLINE CARBURETOR

5. APPROPRIATE HAND TOOLS NECESSARY FOR WORKING ON THE GASOLINE FUEL SYSTEM SUCH AS STRAIGHTEDGES, FEELER GAUGE, WRENCHES, SCREWDRIVERS, PLIERS, AN OXY-ACETYLENE WELDING OUTFIT FOR REPAIRING A FUEL TANK, TUBING CUTTER AND FLARING TOOL FOR CUTTING FUEL LINES WHEN NECESSARY, AND OTHER SPECIALIZED TOOLS FOR VARIOUS CARBURETORS WHICH MAY BE AVAILABLE FROM A LOCAL DEALER

6. OIL, GASOLINE, AND COMMERCIAL CLEANING SOLVENT

7. GASOLINE CONTAINERS AND FUNNELS

F. EXAMPLES OF SUPPORTING REFERENCES

1. FARM TRACTOR TUNE-UP. VAS 3008. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. 1958, PP. 9-10.

   A GENERAL SECTION ON THE FUEL SYSTEM IS FOUND IN THIS PUBLICATION WHICH ILLUSTRATES A PROCEDURE FOR CHECKING THE CARBURETOR FLOAT LEVEL AND PROCEDURES FOR ADJUSTING THE CARBURETOR. THIS MATERIAL IS WRITTEN IN A MANNER THAT SHOULD BE RELATIVELY EASY FOR THE STUDENT TO UNDERSTAND.

2. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATION. 1972, PP. 3-1 - 3-19.

   THIS PUBLICATION INCLUDES MAINTENANCE TIPS AND PRECAUTIONS FOR SERVICING THE CARBURETOR AND A CARBURETOR TROUBLESHOOTING CHART THAT WILL BE HELPFUL TO BOTH TEACHER AND STUDENT. INCLUDED ARE VARIOUS ILLUSTRATIONS THAT EXPLAIN THE PRINCIPLES OF CARBURETION AND DESCRIBE THE FUNCTIONS OF VARIOUS PARTS OF THE GASOLING FUEL SYSTEM.

3. INDIVIDUAL STUDY GUIDE ON CARBURETION. COLUMBUS, OHIO: OHIO AGRICULTURAL EDUCATION CURRICULUM MATERIALS SERVICE, THE OHIO STATE UNIVERSITY. 1970, PP. 1-101.

INCLUDED IN THIS PUBLICATION FOR STUDENT USE ARE VARIOUS PROJECTS OR EXERCISES FOR THE STUDENT TO COMPLETE AS HE STUDIES THE CARBURETION SYSTEM. INCLUDED IS A SECTION ON THE USE OF THE DYNAMOMETER WITH APPROPRIATE DATA SHEETS FOR THE STUDENT TO USE AS HE COMPLETES A DYNAMOMETER TEST ON AN ENGINE.

4. SERVICE MANUALS FOR THE ENGINE BEING WORKED ON

THESE WILL CONTAIN THE TECHNICAL INFORMATION NEEDED TO SERVICE THE GASOLINE FUEL SYSTEM ON THE SPECIFIC ENGINE.

5. TRACTOR MAINTENANCE: PRINCIPLES AND PROCEDURES. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION OF VOCATIONAL INSTRUCTIONAL MATERIALS. 1970, PP. 70-77.

THIS PUBLICATION INCLUDES A BRIEF YET COMPREHENSIVE SECTION ON THE FUNCTION AND PRINCIPLES OF CARBURETION AND IT COVERS THE ADJUSTMENT OF THE IDLE AIR-FUEL MIXTURE AND THE LOAD AIR-FUEL MIXTURE.

THE LP-GAS FUEL SYSTEM

UNIT CONCEPT: VARIOUS STRUCTURES IN THE LP-GAS FUEL SYSTEM MUST BE KEPT PROPERLY ADJUSTED AND SERVICED IN ORDER TO REMOVE THE FUEL FROM THE PRESSURIZED FUEL TANK AND CONVERT THE FUEL INTO A VAPOR THAT CAN BE UTILIZED BY THE CARBURETOR IN PRODUCING AN AIR-FUEL MIXTURE THAT CAN BE CHANGED INTO USABLE ENERGY. REPAIR AND SERVICE OF THE LP-GAS SYSTEM WILL AID IN MINIMIZING SUCH PROBLEMS AS LOSS OF POWER, DIFFICULTY IN STARTING, EXCESSIVE USE OF FUEL AND ROUGH IDLING.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH AN ENGINE WITH AN LP-GAS FUEL SYSTEM, TEST THE SYSTEM FOR LEAKS BY FOLLOWING PROCEDURES DESCRIBED IN THE SERVICE MANUAL.

2. WHEN PROVIDED WITH AN ENGINE WITH MALFUNCTIONS IN THE LP-GAS FUEL SYSTEM, DIAGNOSE THE NATURE OF THE MALFUNCTIONS FOLLOWING APPROVED TROUBLESHOOTING PROCEDURES DETAILED IN THE SERVICE MANUAL.

3. WHEN PROVIDED WITH AN ENGINE WITH PROBLEMS IN THE LP-GAS FUEL SYSTEM, REMOVE, DISASSEMBLE WHEN NECESSARY, AND/OR INSPECT THE FOLLOWING COMPONENTS FOR DEFECTS:

    A. FUEL STRAINER OR FILTER

    B. AIR CLEANER

    C. CARBURETOR

    D. REGULATOR

    E. TANK

4. WHEN PROVIDED WITH AN ENGINE ON WHICH THE PROBLEMS IN THE LP-GAS GUEL SYSTEM HAVE BEEN IDENTIFIED, REASSEMBLE, REPLACE, INSTALL, AND/OR ADJUST THE FOLLOWING COMPONENTS OF THE SYSTEM:

    A. FUEL STRAINER OR FILTER

    B. AIR CLEANER

    C. CARBURETOR

D. REGULATOR

E. TANK

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND/OR MALADJUSTMENTS IN THE LP-GAS FUEL SYSTEM SUCH AS:

   A. LOSS OF POWER

   B. DIFFICULTY IN STARTING

   C. EXCESSIVE FUEL USE

   D. ROUGH IDLING

2. COMPONENTS OF THE LP-GAS FUEL SYSTEM

   A. IDENTIFYING THE PARTS OF THE SYSTEM

   B. DETERMINING THE FUNCTION OF THE PARTS OF THE SYSTEM

   C. PRINCIPLES OF CARBURETION IN THE LP-GAS SYSTEM

3. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE LP-GAS FUEL SYSTEM

4. GENERAL TROUBLESHOOTING PROCEDURES TO IDENTIFY SPECIFIC DEFECTS IN THE LP-GAS FUEL SYSTEM

   A. GENERAL PROCEDURES

   B. TESTING THE SYSTEM FOR LEAKS

   C. SPECIAL SAFETY PRECAUTIONS

5. INSPECTING AND SERVICING SPECIFIC COMPONENTS OF THE LP-GAS FUEL SYSTEM

   A. INSPECTING AND SERVICING THE FUEL TANK

      (1) CHECKING THE TANK FOR LEAKS
      (2) REMOVING THE TANK WHEN NECESSARY
      (3) SERVICING AND REPLACING THE VALVES
      (4) INSTALLING THE TANK

   B. INSPECTING AND SERVICING THE LINES

      (1) CHECKING FOR LEAKS
      (2) REMOVING DEFECTIVE LINES
      (3) REPLACING THE LINES

C. INSPECTING AND SERVICING THE FUEL STRAINER OR FILTER

    (1) DISASSEMBLING THE STRAINER
    (2) INSPECTING AND CLEANING THE STRAINER
    (3) REPLACING THE FILTER ELEMENT

D. INSPECTING AND SERVICING THE REGULATOR

    (1) PROCEDURES AND PRECAUTIONS TO OBSERVE IN REMOVING THE CONVERTER
    (2) PROCEDURES FOR DISASSEMBLING THE CONVERTER AND ADJUSTING THE REGULATOR
    (3) ASSEMBLING THE CONVERTER
    (4) INSTALLING THE CONVERTER AND CHECKING FOR LEAKS

E. INSPECTING AND SERVICING THE LP-GAS SYSTEM CARBURETOR

    (1) REMOVING AND DISASSEMBLING THE CARBURETOR
    (2) INSPECTING THE CARBURETOR PARTS AND INSTALLING REPLACEMENTS WHEN NEEDED
    (3) ASSEMBLING THE CARBURETOR AND MAKING INITIAL ADJUSTMENTS
    (4) INSTALLING THE CARBURETOR AND CHECKING FOR LEAKS
    (5) MAKING FINAL ADJUSTMENTS

F. SERVICING THE AIR CLEANER

    (1) REMOVING, INSPECTING, AND CLEANING THE AIR CLEANER ELEMENT
    (2) REPLACING AND INSTALLING THE AIR CLEANER ELEMENT

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. USING AN ENGINE WITH AN LP-GAS FUEL SYSTEM, HAVE THE STUDENTS TEST THE SYSTEM FOR LEAKS USING WARM SOAPY WATER.

2. HAVE THE STUDENTS USE A SERVICE MANUAL TO IDENTIFY THE POTENTIAL DEFECTS IN THE LP-GAS SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF SYMPTOMS THAT THE STUDENTS OBSERVED ON AN LP-GAS ENGINE.

3. HAVE THE STUDENTS REMOVE AND DISASSEMBLE A CONVERTER AND MEASURE THE DISTANCE FROM THE LOW-PRESSURE REGULATOR LEVER TO THE EDGE OF THE BODY TO DETERMINE IF THE LEVER IS ADJUSTED PROPERLY.

4. HAVE THE STUDENTS REPLACE THE FILTER ELEMENT AND REASSEMBLE THE STRAINER ON AN LP-GAS ENGINE.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. IN THE PROPER ORDER HAVE THE STUDENTS LIST THE PROCEDURES THEY WOULD FOLLOW TO CHECK THE LP-GAS FUEL SYSTEM FOR LEAKS INCLUDING ANY SPECIAL MATERIALS THEY WOULD NEED.

2. DEVELOP A SERIES OF "AGREE AND DISAGREE" STATEMENTS WHICH CONTAIN TWO ELEMENTS. THE FIRST IS A DESCRIPTION OF A SYMPTOM THAT WAS OBSERVED ON AN LP-GAS ENGINE, AND THE SECOND ELEMENT WOULD BE A TENTATIVE DEFECT IN THE LP-GAS SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOM. HAVE THE STUDENT EVALUATE THE STATEMENT REGARDING THE POTENTIAL DEFECT IN TERMS OF "AGREE" - THE DEFECT MAY BE CONTRIBUTING OR CAUSING THE APPEARANCE OF THE SYMPTOM, OR "DISAGREE" - THE DEFECT PROBABLY WOULD NOT CONTRIBUTE TO THE APPEARANCE OF THE SYMPTOM.

3. HAVE THE STUDENTS CHECK THE ADJUSTMENT OF THE REGULATOR LEVERS IN THE CONVERTER ACCORDING TO THE SPECIFICATIONS IN THE SERVICE MANUAL.

4. HAVE THE STUDENTS ADJUST THE REGULATOR LEVELS IN THE CONVERTER IN THE LP-GAS SYSTEM ACCORDING TO THE SPECIFICATIONS IN THE SERVICE MANUAL.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. VARIOUS CONVERTERS FOR STUDENTS TO INSPECT AND ADJUST THE VAPORIZER REGULATOR LEVERS

2. LP-GAS FUEL SYSTEM CARBURETORS FOR THE STUDENTS TO WORK ON

3. VARIOUS FUEL STRAINERS FOR THE STUDENTS TO INSPECT, CLEAN AND REPLACE FILTER ELEMENTS ON

4. APPROPRIATE HAND TOOLS NECESSARY FOR SERVICING THE LP-GAS SYSTEM SUCH AS WRENCHES AND STRAIGHTEDGES

5. WATER, SOAP AND A BRUSH

6. A DYNAMOMETER FOR MAKING FINAL ADJUSTMENTS

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1971, PP. 4-1 - 4-16.

   INCLUDED IN THIS PUBLICATION ARE GENERAL PRACTICES TO FOLLOW IN SERVICING VARIOUS COMPONENTS OF THE LP-GAS FUEL SYSTEM AND AN LP-GAS TROUBLESHOOTING CHART. A BRIEF SECTION IS ALSO INCLUDED WHICH COVERS SAFETY PRECAUTIONS IN WORKING WITH LP-GAS SYSTEMS.

2. HANDLING AND USING GASOLINE AND LIQUEFIED PETROLEUM GAS SAFELY. VAS 3013. URBANA, ILLINOIS: VOCATIONAL AGRICULTURE SERVICE, UNIVERSITY OF ILLINOIS. PP. 3-5.

   THE DISCUSSION OF LP-GAS IN THIS PUBLICATION FOCUSES UPON THE PROPERTIES OF LP-GAS AND SAFETY PRECAUTIONS THAT SHOULD BE OBSERVED IN HANDLING AND USING LP-GAS.

3. SERVICE MANUALS FOR THE ENGINE BEING WORKED ON

   THESE WILL INCLUDE NECESSARY TECHNICAL INFORMATION AND PROCEDURES TO FOLLOW FOR REPAIRING AND SERVICING VARIOUS COMPONENTS OF THE LP-GAS FUEL SYSTEM.

THE DIESEL FUEL SYSTEM

UNIT CONCEPT: THE MAINTENANCE AND REPAIR OF THE DIESEL FUEL SYSTEM WILL INSURE THAT THE PROPER AMOUNT OF ATOMIZED AND PRESSURIZED DIESEL FUEL IS INJECTED INTO EACH CYLINDER WHERE IT IS MIXED WITH HOT COMPRESSED AIR AND COMBUSTION OCCURS. BY MAINTAINING AND SERVICING THE DIESEL FUEL SYSTEM, SUCH PROBLEMS AS DIFFICULTY IN STARTING, ROUGH IDLING, ENGINE KNOCK AND LACK OF POWER WILL BE KEPT AT A MINIMUM.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH A DIESEL ENGINE WITH OBSERVABLE SYMPTOMS OF PROBLEMS OR DEFECTS IN THE DIESEL FUEL SYSTEM, DIAGNOSE THE NATURE OF THE MALFUNCTIONS FOLLOWING APPROVED TROUBLESHOOTING PROCEDURES IN THE SERVICE MANUAL.

2. WHEN PROVIDED WITH AN ENGINE WITH A DIESEL FUEL SYSTEM THAT HAS RUN DRY, BEEN OPENED OR AIR HAS ENTERED THE SYSTEM IN SOME OTHER MANNER, BLEED THE AIR FROM THE SYSTEM FOLLOWING THE PROCEDURES OUTLINED IN THE SERVICE MANUAL.

3. WHEN PROVIDED WITH A DIESEL ENGINE WITH DEFECTS IN THE DIESEL FUEL SYSTEM, REMOVE, DISASSEMBLE WHEN NECESSARY, AND INSPECT, ACCORDING TO THE DIRECTIONS IN THE SERVICE MANUAL, THE FOLLOWING COMPONENTS OF THE DIESEL FUEL SYSTEM:

    A. FUEL TANK
    B. FUEL PUMP
    C. FUEL FILTER
    D. FUEL LINES
    E. INJECTION PUMP
    F. INJECTION NOZZLES
    G. AIR CLEANER

4. WHEN PROVIDED WITH A DIESEL ENGINE IN WHICH THE DEFECTS IN THE DIESEL FUEL SYSTEM HAVE BEEN IDENTIFIED AND LOCATED, REPLACE OR REPAIR, REASSEMBLE WHEN NECESSARY, INSTALL, AND/OR ADJUST, ACCORDING TO THE SERVICE MANUAL, THE FOLLOWING COMPONENTS OF THE DIESEL FUEL SYSTEM:

A. FUEL TANK	E. INJECTION PUMP
B. FUEL PUMP	F. INJECTION NOZZLES
C. FUEL FILTER	F. AIR CLEANER
D. FUEL LINES	

B. INSTRUCTIONAL AREAS

1. DIAGNOSING THE NATURE OF THE DEFECTS AND MALADJUSTMENTS IN THE DIESEL FUEL SYSTEM

    A. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE DIESEL FUEL SYSTEM

        (1) DIFFICULTY IN STARTING
        (2) ROUGH IDLING
        (3) ENGINE KNOCK
        (4) LACK OF POWER

    B. COMPONENTS AND PRINCIPLES OF THE DIESEL FUEL SYSTEM

        (1) IDENTIFYING THE COMPONENTS AND PARTS OF THE DIESEL FUEL SYSTEM
        (2) DETERMINING THE FUNCTIONS OF THE VARIOUS PARTS
        (3) PRINCIPLES OF COMBUSTION IN THE DIESEL ENGINE

    C. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE DIESEL FUEL SYSTEM

    D. GENERAL MAINTENANCE PROCEDURES AND PRECAUTIONS

        (1) DETERMINING WHY IT IS VERY IMPORTANT TO EXERCISE SANITATION AND CLEANLINESS PRACTICES WHEN WORKING ON THE DIESEL FUEL SYSTEM
        (2) USING VARIOUS TYPES OF STARTING AIDS FOR THE DIESEL ENGINE
        (3) PROCEDURES FOR BLEEDING AIR FROM THE DIESEL FUEL SYSTEM

    E. GENERAL TROUBLESHOOTING PROCEDURES USED FOR THE DIESEL FUEL SYSTEM

2. INSPECTING AND SERVICING SPECIFIC COMPONENTS OF THE DIESEL FUEL SYSTEM

    A. INSPECTING AND SERVICING THE FUEL TANK

        (1) CHECKING THE TANK FOR LEAKS

(2) REMOVING THE TANK WHEN NECESSARY
(3) CLEANING AND REPAIRING THE TANK OR REPLACING THE TANK WHEN NECESSARY
(4) INSTALLING THE TANK

B. INSPECTING AND SERVICING THE FUEL LINES

(1) INSPECTING THE LINES AND CONNECTIONS FOR LEAKS
(2) REMOVING THE DEFECTIVE LINES
(3) REPLACING THE FUEL LINES

C. INSPECTING AND SERVICING THE FUEL FILTERS

(1) DISASSEMBLING THE FILTER
(2) REPLACING THE FILTER ELEMENT AND REASSEMBLING THE FILTER
(3) CHECKING THE WATER TRAPS AND DRAINING THE FILTER

D. INSPECTING AND SERVICING THE FUEL PUMP

(1) INSPECTING THE SEDIMENT BOWL BY REMOVING THE BOWL, SCREEN AND GASKET AND CLEANING THE SCREEN OR FILTER AND BOWL
(2) REMOVING THE FUEL PUMP WHICH AS BEEN DETERMINED TO BE DEFECTIVE
(3) INSTALLING A NEW OR REBUILT FUEL PUMP

E. SERVICING THE DIESEL FUEL INJECTION PUMP

(1) REMOVING THE FUEL INJECTION PUMP WHEN NECESSARY
(2) INSTALLING THE INJECTION PUMP
(3) LOCATING THE TIMING MARKS ON THE INJECTION PUMP AND TIMING THE PUMP TO THE ENGINE

F. SERVICING THE INJECTOR NOZZLES

(1) REMOVING THE NOZZLES
(2) INSPECTING THE NOZZLE
(3) CLEANING AND TESTING THE SPRAY PATTERN AND POPPING PRESSURE OF THE NOZZLE WHEN THIS IS DEEMED DESIRABLE
(4) REPLACING AND INSTALLING NOZZLES

G. SERVICING THE AIR CLEANER

(1) REMOVING, INSPECTING AND CLEANING THE AIR CLEANER ELEMENT
(2) REPLACING AND INSTALLING THE AIR CLEANER ELEMENT

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE SYMPTOMS ON A MALFUNCTIONING DIESEL ENGINE THAT HAS DEFECTS IN THE DIESEL FUEL SYSTEM. AFTER THE SYMPTOMS HAVE BEEN OBSERVED, HAVE THE STUDENTS USE SERVICE MANUALS TO IDENTIFY POTENTIAL DEFECTS IN THE DIESEL FUEL SYSTEM THAT MAY BE CONTRIBUTING TO THE SYMPTOMS OBSERVED.

2. USING A DIESEL ENGINE THAT HAS RUN DRY, HAVE THE STUDENTS BLEED THE AIR FROM THE SYSTEM BY FOLLOWING THE PROCEDURES OUTLINED IN THE SERVICE MANUAL.

3. USING A DIESEL ENGINE, HAVE THE STUDENTS REMOVE AN INJECTION NOZZLE AND INSPECT THE NOZZLE TO DETERMINE IF IT SHOULD BE REPLACED.

4. USING A DIESEL ENGINE, HAVE THE STUDENTS INSTALL AN INJECTION PUMP, LOCATE THE TIMING MARKS, AND TIME THE INJECTION PUMP TO THE ENGINE FOLLOWING THE PROCEDURES DETAILED IN THE SERVICE MANUAL.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP AN "AGREE AND DISAGREE" EXERCISE FOR THE STUDENTS TO COMPLETE. DEVELOP A SERIES OF STATEMENTS WHICH DESCRIBE THE SYMPTOMS OBSERVED AND THE POSSIBLE DEFECT(S). HAVE THE STUDENTS REACT TO EACH STATEMENT BY AGREEING OR DISAGREEING WITH THE POSSIBLE DEFECT IN THE DIESEL FUEL SYSTEM FOR THE OBSERVED SYMPTOM. IN THOSE CASES WHERE THE STUDENTS DISAGREE, HAVE THE STUDENTS INDICATE WHAT THEY WOULD BELIEVE TO BE THE MOST LIKELY DEFECT THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOM.

2. HAVE THE STUDENTS RANK, IN THE PROPER ORDER, THE PROCEDURES THEY WOULD FOLLOW TO BLEED THE AIR FROM A DIESEL FUEL SYSTEM ON AN ENGINE THAT RAN OUT OF FUEL OR HAD AIR ENTER THE SYSTEM BY SOME OTHER MEANS.

3. USING A DISPLAY WHICH HAS SEVERAL INJECTOR NOZZLES, SOME BEING DEFECTIVE AND SOME NOT, HAVE THE STUDENTS INSPECT THE NOZZLES AND IDENTIFY THE NOZZLES WHICH ARE DEFECTIVE AND NEED TO BE REPLACED.

4. HAVE THE STUDENTS LIST, IN THE CORRECT SEQUENCE, THE PROCEDURES THEY WOULD FOLLOW IN TIMING THE INJECTION PUMP TO THE ENGINE.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. VARIOUS TYPES OF INJECTORS FOR THE STUDENTS TO EXAMINE FOR DEFECTS

2. APPROPRIATE SPECIALIZED EQUIPMENT SUCH AS A FLO METER, PUMP CALIBRATING STAND AND LAPPING BLOCKS, IF THE TEACHER PLANS TO HAVE THE STUDENTS CLEAN AND TEST THE NOZZLES

3. ENGINES FOR THE STUDENTS TO WORK ON

4. CHARTS SHOWING THE DIAGRAM OF THE DIESEL FUEL SYSTEM

5. APPROPRIATE HAND TOOLS NECESSARY FOR WORKING ON THE DIESEL FUEL SYSTEM SUCH AS WRENCHES, SCREWDRIVERS, PLIERS AND OTHER SPECIALIZED HAND TOOLS, AS MAY BE NEEDED, WHICH MAY BE AVAILABLE FROM A LOCAL DEALER

6. DIESEL FUEL, OIL AND A COMMERCIAL CLEANING SOLVENT

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: ENGINES. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, PP. 5-1 - 5-15.

   INCLUDED IN THIS PUBLICATION, WHICH MAY BE MORE BENEFICIAL TO THE TEACHER THAN THE STUDENT, ARE SECTIONS THAT ARE PARTICULARLY HELPFUL AS BACKGROUND INFORMATION FOR THE DIESEL FUEL INJECTION PUMP AND THE DIESEL FUEL INJECTORS. THE FINAL SECTION OF THE CHAPTER CONTAINS A LIST OF MALFUNCTIONS THAT MAY BE DETECTED IN TROUBLESHOOTING THE DIESEL FUEL SYSTEM.

2. SERVICE MANUALS FOR THE ENGINES BEING WORK ON

   THESE PUBLICATIONS WILL PROVIDE THE PROPER TECHNICAL INFORMATION NECESSARY TO SERVICE THE DIESEL FUEL SYSTEM.

THE ELECTRICAL SYSTEM

UNIT CONCEPT: IN ADDITION TO THE IGNITION CIRCUIT, THE ELECTRICAL SYSTEM IS ALSO COMPOSED OF A CHARGING CIRCUIT, A STARTING CIRCUIT, AND LIGHTING AND ACCESSORY CIRCUITS. BY SERVICING AND MAINTAINING THE COMPONENTS OF THESE VARIOUS CIRCUITS, PROBLEMS SUCH AS LOW BATTERY CHARGE, SLUGGISH STARTING MOTOR OPERATION, DIM LIGHTS AND DEFECTIVE OPERATION OF ELECTRICAL GAUGES WILL BE MINIMIZED OR ELIMINATED.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH AN ENGINE AND EQUIPMENT WITH OBSERVABLE SYMPTOMS THAT MAY BE CAUSED BY DEFECTS IN THE STARTING CIRCUIT, THE CHARGING CIRCUIT, AND/OR THE LIGHTING AND ACCESSORY CIRCUITS, DIAGNOSE THE NATURE OF THE DEFECTS BY FOLLOWING APPROVED TROUBLESHOOTING PROCEDURES DETAILED IN THE SERVICE MANUAL.

2. WHEN PROVIDED WITH EQUIPMENT WITH DEFECTS OR MALADJUSTMENTS IN THE CHARGING CIRCUIT, REMOVE, DISASSEMBLE, TEST, INSPECT, REPLACE, REASSEMBLE, AND INSTALL, ACCORDING TO THE PROCEDURES IN THE SERVICE MANUAL, THE FOLLOWING COMPONENTS OF THE CHARGING CIRCUIT:

    A. GENERATOR

    B. VOLTAGE REGULATOR

    C. ALTERNATOR, IF THE ENGINE IS SO EQUIPPED

3. WHEN PROVIDED WITH EQUIPMENT WITH DEFECTS OR MALADJUSTMENTS IN THE STARTING CIRCUIT, REMOVE, DISASSEMBLE, TEST, INSPECT, REPLACE, REASSEMBLE, AND INSTALL, ACCORDING TO THE PROCEDURES IN THE SERVICE MANUAL, THE FOLLOWING COMPONENTS OF THE STARTING CIRCUIT:

    A. STARTING MOTOR

    B. STARTING SWITCH

    C. EXTERNAL SOLENOID

4. WHEN PROVIDED WITH EQUIPMENT WITH DEFECTS IN THE LIGHTING AND/OR ACCESSORY CIRCUITS, REMOVE, INSPECT, SERVICE, AND INSTALL, ACCORDING TO THE PROCEDURES IN THE SERVICE MANUAL, THE FOLLOWING COMPONENTS OF SUCH CIRCUITS:

   A. SWITCHES

   B. FUSES

   C. WIRES

   D. GAUGES

B. INSTRUCTIONAL AREAS

1. DIAGNOSING THE NATURE OF THE DEFECTS AND MALADJUSTMENTS IN THE STARTING CIRCUIT, CHARGING CIRCUIT, LIGHTING CIRCUIT, AND ACCESSORY CIRCUITS

   A. DETERMINING THE FUNCTIONS OF THE COMPONENTS OF THE CHARGING CIRCUIT AND HOW THESE OPERATE, SUCH AS THE GENERATOR AND VOLTAGE REGULATOR

   B. DETERMINING THE FUNCTIONS OF THE COMPONENTS OF THE STARTING CIRCUIT AND HOW THE VARIOUS COMPONENTS OPERATE, SUCH AS THE STARTER, SOLENOID, BENDIX AND SWITCHES

   C. DETERMINING THE FUNCTION OF PROTECTIVE DEVICES, SUCH AS FUSES AND BREAKERS

   D. GENERAL TROUBLESHOOTING PROCEDURES USED TO LOCATE SPECIFIC PROBLEMS IN THE ELECTRICAL SYSTEM

2. INSPECTING AND SERVICING SPECIFIC CIRCUITS OF THE ELECTRICAL SYSTEM

   A. INSPECTING AND SERVICING THE STARTING CIRCUIT

      (1) REMOVING THE STARTER FROM THE ENGINE
      (2) INSPECTING AND CLEANING THE DRIVE MECHANISM
      (3) REPLACING BRUSHES IN THE STARTER
      (4) REPLACING THE EXTERNAL SOLENOID
      (5) CONDUCTING A NO-LOAD TEST ON THE STARTER
      (6) INSTALLING THE STARTER
      (7) INSPECTING THE IGNITION SWITCH AND REPLACING IT, IF NEEDED

   B. INSPECTING AND SERVICING THE CHARGING CURCUIT

- (1) REMOVING THE GENERATOR
- (2) TESTING THE GENERATOR OUTPUT WITH GENERATOR-REGULATOR TESTER FOR AMPERAGE, VOLTAGE, RESISTANCE
- (3) DISASSEMBLING THE GENERATOR
- (4) CHECKING AND REPLACING THE BRUSHES
- (5) INSTALLING THE GENERATOR
- (6) POLARIZING THE GENERATOR
- (7) ADJUSTING THE GENERATOR BELT TENSION
- (8) REMOVING THE REGULATOR
- (9) CLEANING THE CONTACT POINTS
- (10) REPLACING THE VOLTAGE REGULATOR
- (11) REMOVING AND INSTALLING AN ALTERNATOR, IF AN ENGINE IS SO EQUIPPED

C. INSPECTING AND SERVICING THE LIGHTING CIRCUIT AND OTHER ACCESSORY CIRCUITS

- (1) TESTING CIRCUITS FOR SHORTS, GROUNDS OR OPEN CIRCUITS
- (2) REPLACING FUSES OR CIRCUIT BREAKERS
- (3) REPLACING SWITCHES IN THE CIRCUIT
- (4) REPLACING ANY DEFECTIVE GAUGES
- (5) REPLACING OR REPAIRING DAMAGED ELECTRICAL WIRES

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENT OBSERVE SYMPTOMS IN AN ENGINE WHICH HAS MALADJUSTMENTS OR DEFECTS IN THE STARTING CIRCUIT, CRANKING CIRCUIT, AND LIGHTING CIRCUIT. AFTER THE SYMPTOMS HAVE BEEN LISTED, HAVE THE STUDENTS REFER TO A SERVICE MANUAL TO IDENTIFY POSSIBLE DEFECTS THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS POLARIZE THE GENERATOR BY FOLLOWING THE PROCEDURES DETAILED IN THE SERVICE MANUAL.

3. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS INSPECT AND REPLACE THE BRUSHES IN THE STARTER BY FOLLOWING PROCEDURES IN THE SERVICE MANUAL.

4. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS REMOVE AND REPLACE ELECTRICAL FUSES BEING SURE THAT THE REPLACEMENTS ARE OF THE PROPER SIZE.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN THE SYMPTOMS THAT WERE OBSERVED, AND A SECOND COLUMN SHOULD CONTAIN THE POTENTIAL DEFECTS IN THE CRANKING CIRCUIT, CHARGING CIRCUIT, LIGHTING CIRCUIT, AND OTHER ACCESSORY CIRCUITS THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. A. USING THE ENGINES ON WHICH THE STUDENTS ARE WORKING, HAVE THEM ADJUST THE GENERATOR BELT TENSION SUCH THAT THERE IS A 1/2" DEFLECTION OR WHATEVER SPECIFICATION MAY BE STATED IN THE SERVICE MANUAL.

   B. HAVE THE STUDENTS LIST IN THE CORRECT ORDER THE PROCEDURES THEY WOULD FOLLOW TO POLARIZE THE GENERATOR AFTER A GENERATOR HAS BEEN WORKED ON OR REPLACED AND INSTALLED ON THE ENGINE.

3. HAVE THE STUDENTS DESCRIBE OR LIST THE PROCEDURES THEY WOULD FOLLOW TO CHECK AND CLEAN THE OVERRUNNING CLUTCH DRIVE. THIS LIST SHOULD INCLUDE TURNING THE CLUTCH BY HAND TO SEE WHETHER THE DRIVE TURNS EASILY ON THE SPLINES AND WIPING WITH A CLOTH OR BRUSH AND A CLEANING SOLVENT.

4. PLACE SEVERAL FUSES ON DISPLAY FOR THE STUDENTS TO INSPECT. HAVE THE STUDENTS IDENTIFY THE FUSES BY USING THE FOLLOWING CRITERIA:

   A. WHETHER THE FUSE IS DEFECTIVE OR NOT

   B. WHETHER IT IS A QUICK-BLOWING FUSE OR A SLOW-BLOWING FUSE

   C. WHAT SIZE FUSE WOULD BE NEEDED TO REPLACE IT IF IT NEEDS TO BE REPLACED

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. ENGINES FOR THE STUDENTS TO WORK ON

2. EXAMPLES OF DEFECTIVE PARTS FOR THE STUDENTS TO INSPECT SUCH AS FUSES, SWITCHES, BRUSHES, AND GENERATOR BELT

3. APPROPRIATE SMALL HAND TOOLS FOR THE STUDENTS TO USE SUCH AS WRENCHES, SCREWDRIVERS, PLIERS, WIRE STRIPPER AND CRIMPER, A STRAIGHTEDGE, RULER, AND A SPOON OR RIFFLER FILE TO CLEAN THE REGULATOR CONTACT POINTS

4. SPECIAL TOOLS THAT WILL NEED TO BE USED SUCH AS A REGULATOR-GENERATOR TESTER, AMMETER, VOLTMETER, CARBON PILE RESISTOR, AND A TEST LAMP AND PROBES

5. CLOTH, CLEANING SOLVENT AND CLEANING BRUSHES

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: ELECTRICAL SYSTEMS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, 226 PAGES.

   A VERY COMPREHENSIVE REFERENCE, THIS PUBLICATION DESCRIBES AND ILLUSTRATES ALL CIRCUITS IN THE ELECTRICAL SYSTEM. SECTIONS INCLUDED IN THIS REFERENCE WHICH THE TEACHER MAY FIND ESPECIALLY HELPFUL ARE: (1) A SECTION ON DIAGNOSING AND TESTING OF ELECTRICAL SYSTEMS, AND (2) A SECTION ON THE USE OF TESTING TOOLS AND EQUIPMENT.

2. SERVICE MANUALS FOR THE ENGINE BEING WORKED ON

   THESE WILL PROVIDE NEEDED TECHNICAL INFORMATION AND PROCEDURES TO FOLLOW IN WORKING WITH THE VARIOUS COMPONENTS OF THE CHARGING, CRANKING, LIGHTING, AND ACCESSORY CIRCUITS.

3. THE TRACTOR ELECTRICAL SYSTEM. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION OF VOCATIONAL INSTRUCTIONAL MATERIALS. 1971, 64 PAGES.

   THIS REFERENCE IS ESPECIALLY HELPFUL TO THE TEACHER IN PROVIDING BACKGROUND INFORMATION FOR THE CHARGING CIRCUIT. INCLUDED IS A SECTION ON THE FUNDAMENTALS OF ELECTRICITY WHICH MAY BE HELPFUL TO THE TEACHER BUT MAY BE MORE DETAILED THAN IS NEEDED FOR HIGH SCHOOL STUDENTS.

THE CLUTCH ASSEMBLY

UNIT CONCEPT: THE CLUTCH SYSTEM IS USED ON EQUIPMENT TO CONNECT AND DISCONNECT POWER BETWEEN THE ENGINE AND THE TRANSMISSION. BY MAINTAINING AND SERVICING THE CLUTCH ASSEMBLY, PROBLEMS SUCH AS CHATTERING, DRAGGING, GRABBING AND SLIPPING MAY BE ELIMINATED.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH EQUIPMENT WITH DEFECTS IN THE CLUTCH SYSTEM, PROPERLY DIAGNOSE THE NATURE OF THE MALFUNCTION(S) BY FOLLOWING APPROVED TROUBLESHOOTING PROCEDURES DETAILED IN THE SERVICE MANUAL.

2. WHEN PROVIDED WITH EQUIPMENT WITH AN INCORRECT AMOUNT OF FREE PEDAL TRAVEL, ADJUST CLUTCH LINKAGE BY FOLLOWING THE PROCEDURES IN THE SERVICE MANUAL.

3. WHEN PROVIDED WITH EQUIPMENT WITH MALFUNCTIONS IN THE CLUTCH ASSEMBLY, REMOVE, DISASSEMBLE, INSPECT, REPAIR OR REPLACE, REASSEMBLE AND INSTALL, ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS, THE FOLLOWING COMPONENTS OF THE CLUTCH ASSEMBLY:

    A. CLUTCH DISK
    B. PRESSURE PLATE
    C. PILOT BEARING AND RELEASE BEARING
    D. CLUTCH SPRINGS
    E. FLYWHEEL
    F. CLUTCH SHAFT

B. INSTRUCTIONAL AREAS

1. DIAGNOSING THE NATURE OF THE DEFECTS AND MALADJUSTMENTS IN THE CLUTCH ASSEMBLY

    A. IDENTIFYING SYMPTOMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE CLUTCH ASSEMBLY SUCH AS:

        (1) CHATTERING
        (2) CLUTCH DRAGGING
        (3) CLUTCH SLIPPING

B. COMPONENTS OF THE CLUTCH ASSEMBLY

  (1) IDENTIFYING THE PARTS
  (2) DETERMINING THEIR FUNCTION
  (3) IDENTIFYING THE VARIOUS TYPES OF CLUTCHES

C. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE CLUTCH ASSEMBLY

D. GENERAL PROCEDURES FOR TROUBLESHOOTING THE CLUTCH ASSEMBLY AFTER VARIOUS SYMPTOMS HAVE BEEN OBSERVED

2. INSPECTING AND ADJUSTING THE CLUTCH LINKAGE

A. DETERMINING WHAT AMOUNT OF FREE PEDAL TRAVEL IS ON THE EQUIPMENT AND WHAT THE MANUFACTURER'S SPECIFICATIONS ARE

B. INSPECTING THE CLUTCH LINKAGE FOR WORN OR BENT PARTS AND INSTALLING REPLACEMENTS

C. LOOSENING THE ADJUSTING SCREW OR FOLLOWING OTHER PROCEDURES IN THE SERVICE MANUAL TO ADJUST THE FREE PEDAL TRAVEL

D. CHECKING THE FREE PEDAL TRAVEL AFTER THE ADJUSTMENT HAS BEEN MADE TO DETERMINE IF IT IS CORRECT

3. INSPECTING AND SERVICING THE CLUTCH ASSEMBLY

A. SEPARATING THE TRACTOR TO GET AT THE CLUTCH ASSEMBLY

B. REMOVING THE CLUTCH ASSEMBLY

C. CHECKING THE FLYWHEEL FRICTION DRIVING SURFACE FOR FLATNESS OR ROUGHNESS

D. INSPECTING THE PILOT BEARING AND REPLACING THE BEARING AND THRUST WASHER, IF NECESSARY

E. INSPECTING THE RELEASE BEARING ASSEMBLY INCLUDING THE FORK AND MAKING NECESSARY REPLACEMENTS

F. INSPECTING THE CLUTCH DISKS FOR CRACKS OR LOOSE RIVETS

G. CHECKING THE CLUTCH PLATE FOR WARPAGE

H. INSPECTING THE SPRINGS FOR CORROSION, PITTING OR DISTORTION

I. CHECKING THE SPLINE FOR WEAR AS A INDICATOR OF MISALIGNMENT

J. REASSEMBLING THE CLUTCH PACK AND ADJUSTING SPRING TENSION

K. INSTALLING THE CLUTCH PACK AND ADJUSTING THE RELEASE LEVERS

L. REJOINING THE TRACTOR

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE AND LIST THE SYMPTOMS THEY OBSERVED ON EQUIPMENT WHICH HAD MALADJUSTMENTS IN THE CLUTCH ASSEMBLY. AFTER THE OBSERVED SYMPTOMS HAVE BEEN LISTED, HAVE THE STUDENTS REFER TO A SERVICE MANUAL TO IDENTIFY POSSIBLE DEFECTS IN THE CLUTCH ASSEMBLY THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE OBSERVED SYMPTOMS.

2. HAVE THE STUDENTS CHECK THE AMOUNT OF CLUTCH PEDAL FREE TRAVEL AGAINST THE MANUFACTURER'S SPECIFICATIONS AND THEN ADJUST THE PEDAL FREE TRAVEL TO SATISFY THE SPECIFICATIONS IN THE SERVICE MANUAL.

3. HAVE THE STUDENTS REMOVE THE CLUTCH RELASE BEARING FROM THE CARRIER AND INSPECT IT FOR DAMAGE, ROUGHNESS OR WEAR. REPACK THE BEARING WITH HIGH TEMPERATURE GREASE AND INSTALL THE BEARING ON THE CARRIER, BEING SURE TO REMOVE ANY EXCESS GREASE.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN THE SYMPTOMS THAT WERE OBSERVED AND THE SECOND COLUMN SHOULD CONTAIN DEFECTS IN THE CLUTCH ASSEMBLY THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. HAVE THE STUDENTS LIST THE GENERAL PROCEDURES THEY WOULD FOLLOW TO ADJUST THE CLUTCH PEDAL FREE TRAVEL INCLUDING ANY TOOLS THEY WOULD NEED TO DETERMINE THE AMOUNT OF FREE TRAVEL.

3. HAVE THE STUDENTS REPACK A BEARING SUCH AS ONE WHICH MAY BE FOUND IN THE CLUTCH ASSEMBLY. EVALUATE THE STUDENTS BY CONSIDERING WHETHER THE OLD GREASE HAS BEEN REMOVED, HOW WELL THE GREASE HAS "FILLED" AROUND THE BEARINGS, THE AMOUNT OF EXCESS GREASE ON THE BEARING, AND THE TYPE OF LUBRICANT USED.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EQUIPMENT FOR THE STUDENTS TO WORK ON
2. EXAMPLES OF DEFECTIVE RELEASE BEARINGS, PILOT BEARINGS, DISKS AND PLATES FOR THE STUDENTS TO INSPECT
3. APPROPRIATE TOOLS AND EQUIPMENT SUCH AS A STRAIGHTEDGE, FEELER GAUGE, WRENCHES, TRACTOR SUPPORTS, JACKS, BLOCKING, PLIERS, SCREWDRIVERS, SOCKET SET, CLUTCH ALIGNING TOOL, AND HAMMERS
4. HIGH TEMPERATURE GREASE FOR REPACKING BEARINGS AND CLOTH

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: POWER TRAINS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, PP. 2-1 - 2-20.

   THIS PUBLICATION INCLUDES A DISCUSSION OF THE VARIOUS TYPES OF CLUTCHES AND THE FUNCTION OF THE CLUTCH SYSTEM AND ITS COMPONENTS. INCLUDED ARE PROCEDURES TO USE FOR CHECKING THE CLUTCH PLATE FOR WARPING, CHECKING THE FLYWHEEL FRICTION SURFACE FOR ROUGHNESS, AND CHECKING THE CLUTCH SPRING TENSION. A CHART IS ALSO INCLUDED WHICH LISTS THE POSSIBLE PROBLEMS AND CAUSES OF CLUTCH SYSTEM FAILURES.

2. SERVICE MANUALS FOR THE EQUIPMENT BEING WORKED ON

   THESE WILL INCLUDE APPROPRIATE TECHNICAL INFORMATION FOR ADJUSTING THE CLUTCH PEDAL FREE TRAVEL AND SPRING TENSION ALONG WITH A TROUBLESHOOTING CHART FOR DIAGNOSING CLUTCH SYSTEM PROBLEMS.

3. TRACTOR MAINTENANCE: PRINCIPLES AND PROCEDURES. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS. 1970, PP. 83-87.

   INCLUDED IN THIS PUBLICATION WITH THE ILLUSTRATIONS IS A STEP-BY-STEP PROCEDURE FOR ADJUSTING BOTH FOOT-OPERATED AND HAND-OPERATED CLUTCHES.

THE TRANSMISSION SYSTEM

UNIT CONCEPT: THE TRANSMISSION IS USED ON AGRICULTURAL EQUIPMENT TO TRANSFER THE ENGINE POWER TO THE DRIVE WHEELS OF THE EQUIPMENT. THE TRANSMISSION ACHIEVES THIS FUNCTION BY COMPLETING TWO TASKS: (A) SELECTING SPEED RATIOS FOR VARIOUS SPEEDS OF TRAVEL, AND (B) REVERSING THE TRAVEL OF THE EQUIPMENT. SERVICING AND MAINTAINING THE TRANSMISSION WILL AID IN MINIMIZING OR ELIMINATING PROBLEMS SUCH AS TRANSMISSION NOISE, DIFFICULTY IN SHIFTING, SLIPPING OUT OF GEAR, AND OIL LEAKAGE.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH EQUIPMENT WITH SYMPTOMS INDICATING DEFECTS OR MALADJUSTMENTS IN THE TRANSMISSION, DIAGNOSE THE NATURE OF THE DEFECT BY FOLLOWING APPROVED TROUBLESHOOTING PROCEDURES.

2. WHEN PROVIDED WITH EQUIPMENT WITH DEFECTS IN THE TRANSMISSION SYSTEM, REMOVE, DISASSEMBLE IF NECESSARY, INSPECT, REASSEMBLE IF NECESSARY, REPLACE, INSTALL, AND ADJUST THE TRANSMISSION FOLLOWING THE PROCEDURES AND SPECIFICATIONS IN THE SERVICE MANUAL.

3. WHEN PROVIDED WITH EQUIPMENT THAT NEEDS TO HAVE THE TRANSMISSION OIL CHANGED OR CHECKED, CHANGE OR ADD TRANSMISSION OIL BEING CERTAIN THAT THE OIL RECOMMENDED IN THE SERVICE MANUAL IS USED.

B. INSTRUCTIONAL AREAS

1. DIAGNOSING THE NATURE OF THE DEFECTS AND MALADJUSTMENTS IN THE TRANSMISSION

   A. GENERAL TRANSMISSION SYSTEM TROUBLESHOOTING PROCEDURES

   B. IDENTIFYING THE SYNCHRONIZING UNITS OF TRANSMISSIONS

   C. THE TYPES AND OPERATION OF SELECTIVE AND HYDRAULIC ACTIVATED TRANSMISSIONS

   D. OPERATION OF THE TORQUE AMPLIFIER DRIVE AND TRANSMISSION CONTROLS

2. INSPECTING AND SERVICING THE TRANSMISSION SYSTEM

   A. GENERAL MAINTENANCE PROCEDURES FOR THE TRANSMISSION SYSTEM

      (1) OBSERVING AND PRACTICING SANITATION PRACTICES WHEN WORKING WITH THE TRANSMISSION SYSTEM
      (2) CHECKING THE TRANSMISSION OIL LEVEL AND ADDING OIL
      (3) DRAINING AND FILLING THE TRANSMISSION

   B. INSPECTING AND SERVICING THE INTERNAL COMPONENTS OF THE TRANSMISSION

      (1) OPENING THE TRANSMISSION FOR INSPECTING OF THE GEARS AND SHAFTS BY REMOVING THE TRANSMISSION TOP AND SEPARATING THE TRACTOR
      (2) IDENTIFYING VARIOUS GEAR TOOTH WEAR AND FAILURES SUCH AS ABRASIVE WEAR, SCORING, PITTING, ROLLING AND PEENING, AND BREAKAGE
      (3) REMOVING AND REPLACING DEFECTIVE SHAFTS AND GEARS
      (4) REPLACING DEFECTIVE TRANSMISSION OIL SEALS
      (5) REPLACING DEFECTIVE BEARINGS AND PRE-LOADING BEARINGS AND SHAFTS
      (6) CHECKING FOR ENDPLAY
      (7) CHECKING FOR BACKLASH
      (8) REJOINING THE TRACTOR
      (9) CHECKING THE TRANSMISSION AFTER IT HAS BEEN REPAIRED OR SERVICED

   C. INSPECTING AND SERVICING THE SHIFTER CONTROLS

      (1) REMOVING AND REPLACING DEFECTIVE LATCHES, SHIFT LEVERS, PIVOTS AND THRUST WASHERS
      (2) ADJUSTING THE SHIFTING LINKAGE BY FOLLOWING PROCEDURES IN THE SERVICE MANUAL

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE AND LIST THE SYMPTOMS THEY OBSERVED ON EQUIPMENT WHICH HAD MALADJUSTMENTS IN THE TRANSMISSION SYSTEM. AFTER THE SYMPTOMS HAVE BEEN LISTED, HAVE THE STUDENTS REFER TO A SERVICE MANUAL TO IDENTIFY POSSIBLE DEFECTS IN THE TRANSMISSION SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE OBSERVED SYMPTOMS.

2. HAVE THE STUDENTS USE A DIAL INDICATOR TO CHECK THE ENDPLAY OF THE TRANSMISSION DRIVE SHAFT. IF ENDPLAY NEEDS TO BE CORRECTED TO MEET THE MANUFACTURER'S SPECIFICATIONS, HAVE THE STUDENTS REMOVE OR ADD SHIMS UNDER THE FRONT BEARING HOUSING TO CORRECT THE ENDPLAY TO THE MANUFACTURER'S SPECIFICATIONS.

3. HAVE THE STUDENTS CHECK THE LEVEL OF THE OIL IN THE TRANSMISSION AND ADD OIL OF THE PROPER TYPE UNTIL THE PROPER LEVEL OF OIL IS REACHED.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN THE SYMPTOMS THAT WERE OBSERVED AND THE SECOND COLUMN SHOULD CONTAIN DEFECTS IN THE TRANSMISSION SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. PRESENT A SKETCH OF A DIAL INDICATOR THAT SHOWS A READING OBTAINED WHEN CHECKING THE ENDPLAY OF A TRANSMISSION DRIVE SHAFT IN ADDITION TO THE MANUFACTURER'S SPECIFICATION. FROM THIS INFORMATION, HAVE THE STUDENTS DETERMINE WHETHER THE READING FALLS WITHIN THE MANUFACTURER'S RECOMMENDED RANGE AND, IF IT IS NOT WITHIN THE RANGE, HAVE THE STUDENTS DESCRIBE THE PROCEDURES THEY WOULD FOLLOW TO BRING THE ENDPLAY WITHIN THE DESIRED RANGE.

3. HAVE THE STUDENTS SELECT THE PROPER OIL TO BE ADDED TO THE TRANSMISSION SYSTEM ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EQUIPMENT WITH TRANSMISSIONS FOR THE STUDENTS TO WORK ON

2. EXAMPLES OF GEARS, BEARINGS AND OIL SEALS FOR THE STUDENTS TO INSPECT FOR DEFECTS

3. CHARTS SHOWING THE VARIOUS TYPES OF TRANSMISSIONS

4. APPROPRIATE SMALL HAND TOOLS SUCH AS WRENCHES, PLIERS, SCREWDRIVERS, SOCKET SETS AND HAMMERS

5. SPECIAL EQUIPMENT AND TOOLS SUCH AS A DIAL INDICATOR, TRACTOR SUPPORTS, HOIST, BLOCKS AND SNAP RING EXPANDER

6. TRANSMISSION OIL AND OIL CAN

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: POWER TRAINS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATION. 1972, PP. 3-1 - 6-12.

THIS PUBLICATION DISCUSSES AND ILLUSTRATES THE OPERATION OF MECHANICAL AND HYDRAULIC ASSIST TRANSMISSIONS, HYDROSTATIC DRIVES AND TORQUE CONVERTERS. A CONDENSED TROUBLESHOOTING CHART IS PROVIDED AT THE END OF EACH SECTION WHICH INDICATES THE POSSIBLE CAUSE OF THE PROBLEM AND THE REMEDY TO FOLLOW IN ALLEVIATING THE PROBLEM.

2. SERVICE MANUALS FOR THE TRANSMISSION BEING WORKED ON

   THESE PUBLICATIONS WILL PROVIDE THE NECESSARY TECHNICAL INFORMATION AND SPECIFICATIONS THAT ARE NEEDED FOR PRELOADING, CHECKING BACKLASH, CHECKING ENDPLAY, AND REPAIRING THE SHIFT LINKAGE.

3. TRACTOR TRANSMISSIONS. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION FOR VOCATIONAL MATERIALS. 32 PAGES.

   THIS REFERENCE PROVIDES BASIC INFORMATION WHICH STUDENTS AND TEACHERS WILL FIND HELPFUL IN UNDERSTANDING THE FUNCTION AND OPERATION OF VARIOUS PARTS OF THE TRANSMISSION. INCLUDED AT THE END OF THE PUBLICATION IS A GLOSSARY OF TERMS WHICH ONE ENCOUNTERS WHEN READING THE TECHNICAL SERVICE MANUALS.

THE DIFFERENTIAL AND FINAL DRIVE ASSEMBLY

UNIT CONCEPT: THE DIFFERENTIAL ASSEMBLY TRANSMITS POWER "AROUND THE CORNER" TO THE DRIVE AXLES AND ENABLES EACH DRIVE WHEEL TO ROTATE AT DIFFERENT SPEEDS. THE FINAL DRIVE ASSEMBLY GIVES THE FINAL REDUCTION IN SPEED AND INCREASE IN TORQUE TO THE DRIVE WHEELS. SERVICING AND MAINTAINING THE DIFFERENTIAL AND FINAL DRIVE WILL AID IN MINIMIZING PROBLEMS SUCH AS EXCESSIVE NOISE IN THE DIFFERENTIAL, OVERHEATING IN THE FINAL DRIVE ASSEMBLY OR LOSS OF LUBRICANT FROM THE FINAL DRIVE ASSEMBLY.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH EQUIPMENT WITH SYMPTOMS THAT MAY INDICATE THERE ARE MALADJUSTMENTS IN THE DIFFERENTIAL AND/OR FINAL DRIVE ASSEMBLY, PROPERLY DIAGNOSE THE NATURE OF THE MALADJUSTMENTS BY FOLLOWING PROCEDURES DESCRIBED IN THE SERVICE MANUAL.

2. WHEN PROVIDED WITH EQUIPMENT WITH A DIFFERENTIAL ASSEMBLY AND FINAL DRIVE SYSTEM, PERFORM THE GENERAL MAINTENANCE REQUIREMENTS BY FOLLOWING THE PROCEDURES IN THE SERVICE MANUAL.

3. WHEN PROVIDED WITH EQUIPMENT WITH DEFECTS IN THE DIFFERENTIAL, REMOVE, DISASSEMBLE, INSPECT, REPLACE, REASSEMBLE, INSTALL AND ADJUST THE COMPONENTS IN THE DIFFERENTIAL.

4. WHEN PROVIDED WITH EQUIPMENT WITH DEFECTS IN THE FINAL DRIVE SYSTEM, REMOVE, DISASSEMBLE, INSPECT, REPLACE, REASSEMBLE, INSTALL AND ADJUST WHEN NECESSARY THE COMPONENTS OF THE FINAL DRIVE SYSTEM.

B. INSTRUCTIONAL AREAS

1. DIAGNOSING THE NATURE OF THE DEFECTS AND MALADJUSTMENTS IN THE DIFFERENTIAL AND FINAL DRIVE ASSEMBLY

   A. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE DIFFERENTIAL AND FINAL DRIVE ASSEMBLY SUCH AS:

        (1) EXCESSIVE NOISE
        (2) LOSS OF OIL
        (3) OVERHEATING

    B. COMPONENTS OF THE FINAL DRIVE AND DIFFERENTIAL ASSEMBLY

        (1) IDENTIFYING THE PARTS OF THE SYSTEM
        (2) DETERMINING THE FUNCTION OF THE PARTS AND SYSTEM
        (3) PRINCIPLES OF GEARS AND GEAR RATIOS

    C. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE DIFFERENTIAL AND FINAL DRIVE ASSEMBLY

    D. GENERAL TROUBLESHOOTING PROCEDURES USED TO LOCATE SPECIFIC DEFECTS IN THE DIFFERENTIAL AND FINAL DRIVE ASSEMBLY

2. INSPECTING AND SERVICING THE DIFFERENTIAL ASSEMBLY AND THE FINAL DRIVE SYSTEM

    A. MAINTAINING THE DIFFERENTIAL AND FINAL DRIVE

        (1) CHECKING THE FLUID LEVEL IN THE REAR AXLE
        (2) DRAINING THE OIL FROM THE REAR AXLE HOUSING
        (3) FLUSHING THE REAR AXLE HOUSING
        (4) ADDING THE PROPER GEAR OIL TO THE REAR AXLE HOUSING

    B. INSPECTING AND SERVICING THE FINAL DRIVE

        (1) PROCEDURES FOR REMOVING VARIOUS COMPONENTS OF THE FINAL DRIVE SYSTEM
        (2) INSPECTING FOR GEAR WEAR AND REPLACING DAMAGED PARTS
        (3) INSPECTING FOR PITTED OR SCORED BEARINGS, REPLACING BEARINGS AND PRE-LOADING BEARINGS
        (4) INSPECTING FOR DAMAGED OIL SEALS AND REPLACING OIL SEALS
        (5) INSPECTING FOR CRACKED OR BROKEN PARTS
        (6) CHECKING AND ADJUSTING ENDPLAY FOR SOME TYPES OF DRIVE AXLES
        (7) REASSEMBLING THE FINAL DRIVE ASSEMBLY

    C. INSPECTING AND SERVICING THE DIFFERENTIAL

        (1) REMOVING THE DIFFERENTIAL
        (2) INSPECTING THE DIFFERENTIAL ASSEMBLY FOR DEFECTS IN THE RING GEAR, BEVEL GEAR AND BEARINGS
        (3) INSTALLING THE NEW DIFFERENTIAL ASSEMBLY IF ONE IS NEEDED
        (4) MAKING THE BEARING PRE-LOAD ADJUSTMENT AND CHECKING GEAR BACKLASH

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE EQUIPMENT WITH DEFECTS IN THE DIFFERENTIAL OR FINAL DRIVE AND LIST THE SYMPTOMS THEY HAVE OBSERVED. USING A SERVICE MANUAL, HAVE THE STUDENTS LIST THE DEFECTS IN THE DIFFERENTIAL AND FINAL DRIVE THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOM(S).

2. USING THE EQUIPMENT ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS DRAIN, FLUSH AND REFILL THE REAR AXLE HOUSING WITH APPROPRIATE GEAR OIL.

3. USING THE EQUIPMENT ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS INSPECT THE RING GEAR FOR EXCESSIVE WEAR AND BROKEN OR CHIPPED TEETH.

4. USING THE EQUIPMENT ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS INSPECT THE OIL SEALS AND BEARINGS FOR DAMAGE SUCH AS CRACKS IN THE OIL SEAL OR EXCESSIVE WEAR AND SCORING OR PITTING ON THE BEARINGS.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN SYMPTOMS THAT WERE OBSERVED. A SECOND COLUMN SHOULD CONTAIN POTENTIAL DEFECTS IN THE DIFFERENTIAL AND FINAL DRIVE. HAVE THE STUDENTS COMPLETE THE MATCHING EXERCISE WITH 80% ACCURACY.

2. HAVE THE STUDENTS LIST THE PROCEDURES THEY WOULD FOLLOW IN THE PROPER ORDER FOR FLUSHING THE REAR AXLE HOUSING.

3. PRESENT A SKETCH WHICH SHOWS THE FACE OF A DIAL INDICATOR WITH A READING OBTAINED WHEN CHECKING THE BACKLASH BETWEEN THE RING GEAR AND THE DIFFERENTIAL DRIVE SHAFT PINION. USING THE SERVICE MANUAL, HAVE THE STUDENTS DETERMINE WHETHER THIS FALLS WITHIN THE MANUFACTURER'S SPECIFICATIONS AND LIST PROCEDURES THEY WOULD FOLLOW TO INCREASE BACKLASH OR DECREASE BACKLASH.

4. PRESENT THE STUDENTS WITH A DISPLAY OF BEARINGS AND OIL SEALS THAT ARE COMMONLY USED IN THE FINAL DRIVE. HAVE THE STUDENTS IDENTIFY THOSE SEALS AND BEARINGS WHICH ARE DEFECTIVE AND THEY WOULD RECOMMEND BE REPLACED.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EQUIPMENT FOR THE STUDENTS TO WORK ON

2. EXAMPLES OF SEALS AND BEARINGS WITH DEFECTS FOR THE STUDENTS TO INSPECT

3. A DIFFERENTIAL UNIT REMOVED FROM THE EQUIPMENT FOR THE STUDENTS TO INSPECT

4. CHARTS SHOWING THE VARIOUS TYPES [illegible]VES

5. APPROPRIATE TOOLS AND EQUIPMENT SUC[illegible]AL INDICATORS, TORQUE WRENCH, SHIMS, HOIST, TRACTOR STANDS, BLOCKING, CHAINS, SNAP RING EXPANDER PLIERS, WRENCHES, PLIERS, SCREWDRIVERS, BRASS DRIFT AND HAMMERS

6. GEAR-OIL, SOLVENT AND CLOTH

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: POWER TRAINS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, PP. 7-1 - 8-8.

   THIS PUBLICATION DISCUSSES VERY BRIEFLY BOTH THE DIFFERENTIAL AND FINAL DRIVE COMPONENTS AND INCLUDES A BRIEF SECTION ON TROUBLESHOOTING THESE TWO COMPONENTS AND POSSIBLE CAUSES OF THE MALFUNCTION(S). THIS PUBLICATION WILL NEED TO BE SUPPLEMENTED WITH THE APPROPRIATE SERVICE MANUAL WHEN STUDENTS ARE WORKING WITH THE DIFFERENTIAL AND FINAL DRIVE ASSEMBLY.

2. SERVICE MANUALS FOR THE EQUIPMENT BEING WORKED ON

   THESE WILL INCLUDE SPECIFIC INFORMATION NEEDED FOR PRE-LOADING BEARINGS AND ADJUSTING ENDPLAY.

THE BRAKING SYSTEM

UNIT CONCEPT: THE SAFE OPERATION OF EQUIPMENT MAY BE ENHANCED BY MAINTAINING AND SERVICING THE BRAKE SYSTEM AND ELIMINATING PROBLEMS SUCH AS LOSS OF BRAKING CAPACITY, BRAKES DO NOT RELEASE, EXCESSIVE PEDAL TRAVEL, AND EXCESSIVE SETTLING OF BRAKE PEDALS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. GIVEN EQUIPMENT WITH MALFUNCTIONS IN THE BRAKE SYSTEM, CORRECTLY DIAGNOSE THE NATURE OF THE MALFUNCTION BY FOLLOWING PROCEDURES DETAILED IN THE SERVICE MANUAL.
2. PROVIDED EQUIPMENT WITH A BRAKING SYSTEM, ADJUST THE BRAKES AND PERFORM OTHER GENERAL MAINTENANCE REQUIREMENTS AS DETAILED IN THE SERVICE MANUAL.
3. PROVIDED EQUIPMENT WITH DEFECTS IN THE BRAKE MECHANISM, REMOVE, DISASSEMBLE, INSPECT, REPAIR OR SERVICE, ASSEMBLE AND INSTALL THE BRAKE MECHANISM BY FOLLOWING PROCEDURES DETAILED IN THE SERVICE MANUAL.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE BRAKING SYSTEM SUCH AS:
    - A. LOSS OF BRAKING CAPACITY
    - B. BRAKES FAIL TO RELEASE
    - C. EXCESSIVE PEDAL TRAVEL
2. COMPONENTS OF THE BRAKING SYSTEM
    - A. IDENTIFYING THE PARTS
    - B. DETERMINING THE FUNCTION OF THE PARTS
    - C. TYPES OF BRAKE SYSTEMS
3. DETERMINING THE MAJOR REASONS OR CAUSES FOR BRAKE DIFFICULTIES
4. PROCEDURES FOR TROUBLESHOOTING THE BRAKE SYSTEM FOR SPECIFIC DEFECTS

5. INSPECTING AND SERVICING THE BRAKE SYSTEM

   A. PERFORMING GENERAL MAINTENANCE REQUIREMENTS

      (1) ADJUSTING MECHANICAL BRAKES

         (A) IDENTIFYING THE TYPE OF ADJUSTMENT ON THE EQUIPMENT SUCH AS A LOCK-NUT AND YOKE OR SIDE ADJUSTMENT
         (B) JACKING UP THE EQUIPMENT UNTIL THE WHEELS CLEAR THE FLOOR OR GROUND
         (C) TIGHTENING THE ADJUSTING SCREW, ADJUSTING ROD OR ADJUSTING NUT
         (D) CHECKING THE "DRAG" ON EQUIPMENT WITH SHOE BRAKE
         (E) CHECKING THE FREE FOOT-PEDAL TRAVEL FOR BOTH FOOT PEDALS
         (F) CHECKING THAT THE BRAKES ARE EQUALIZED
         (G) LOWERING THE EQUIPMENT FROM THE JACKS

      (2) ADJUSTING HYDRAULIC BRAKES

         (A) CHECKING THE FLUID LEVEL
         (B) ADJUSTING THE LOCK-NUT AND SCREW ARRANGEMENT
         (C) BLEEDING AIR FROM THE SYSTEM

   B. INSPECTING AND SERVICING SPECIFIC COMPONENTS OF THE BRAKE SYSTEM

      (1) DISASSEMBLING THE BRAKE MECHANISM
      (2) INSPECTING THE BRAKE LINING FOR WORN LINING OR LOOSE RIVETS
      (3) INSPECTING THE DISC FOR EXCESSIVE PLAY AND WARPAGE AND REPLACING THE BRAKE DISC
      (4) REASSEMBLING THE BRAKE MECHANISM
      (5) ADJUSTING THE BRAKES

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE EQUIPMENT THAT HAS MALADJUSTMENTS IN THE BRAKE SYSTEM. AFTER OBSERVING THE SYMPTOMS, HAVE THE STUDENTS USE A SERVICE MANUAL TO IDENTIFY THE DEFECTS IN THE BRAKE SYSTEM THAT MAY BE CAUSING OR CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. USING EQUIPMENT ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS ADJUST THE MECHANICAL BRAKES ON THE EQUIPMENT. THE STUDENTS SHOULD BE SURE TO CHECK AND ADJUST THE BRAKE PEDAL FREE TRAVEL.

3. HAVE THE STUDENTS INSPECT THE BACKING PLATE FROM A HYDRAULIC BRAKE SYSTEM FOR WORN LINING OR LOOSE RIVETS AND THE BRAKE DISC FOR LOOSE OR EXCESSIVE PLAY ON THE FINAL DRIVE SHAFT AND FOR WARPING.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN SYMPTOMS THAT WERE OBSERVED. A SECOND COLUMN SHOULD CONTAIN POTENTIAL DEFECTS IN THE BRAKE SYSTEM. HAVE THE STUDENTS COMPLETE THE MATCHING EXERCISE BY MATCHING THE POTENTIAL DEFECT(S) WITH THE SYMPTOM.

2. HAVE THE STUDENTS LIST THE PROCEDURES THEY WOULD FOLLOW TO MAKE SURE THAT ON EQUIPMENT WITH TWO BRAKE PEDALS, SUCH AS ON A FARM TRACTOR, THE BRAKES ARE EQUALIZED. THE TEACHER SHOULD EVALUATE THE LIST BEING CERTAIN THE STUDENT INDICATES JACKING UP THE EQUIPMENT SO THAT THE WHEELS CLEAR THE FLOOR, STARTING THE ENGINE AND ENGAGING THE CLUTCH TO ROTATE THE WHEELS, SHIFTING INTO NEUTRAL, APPLYING THE BRAKES, AND OBSERVING IF ONE WHEEL SLOWS BEFORE THE OTHER.

3. PRESENT THE STUDENTS WITH BACKING PLATES WITH BRAKE LINING INSTALLED. HAVE THE STUDENTS INSPECT THE PLATES AND INDICATE WHICH PLATES HAVE LINING THAT MUST BE REPLACED AND INDICATE WHY THE LINING NEEDS TO BE REPLACED.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. VARIOUS TYPES OF EQUIPMENT WITH BRAKE SYSTEMS

2. EXAMPLES OF BRAKE DISCS, BACKING PLATES, AND BANDS WITH DEFECTS FOR THE STUDENTS TO INSPECT

3. CHARTS WHICH SHOW VARIOUS TYPES OF BRAKING SYSTEMS USED ON EQUIPMENT

4. HYDRAULIC OIL (BRAKE FLUID)

F. EXAMPLES OF SUPPORTING REFERENCES

1. SERVICE MANUALS FOR THE EQUIPMENT BEING WORKED ON

   THESE PUBLICATIONS WILL PROVIDE THE PROPER TECHNICAL INFORMATION NECESSARY TO SERVICE THE BRAKE SYSTEM.

2. TRACTOR MAINTENANCE: PRINCIPLES AND PROCEDURES. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS. 1970, PP. 77-82.

THIS PUBLICATION COVERS THE VARIOUS TYPES OF BRAKES AND THEIR OPERATION ALONG WITH A STEP-BY-STEP PROCEDURE FOR ADJUSTING THE BRAKES. STUDENTS SHOULD FIND THIS TO BE A RELATIVELY EASY TO UNDERSTAND PRESENTATION OF THE BRAKE SYSTEM. ILLUSTRATIONS PROVIDED IN THE PUBLICATION MAY BE VERY BENEFICIAL TO THE TEACHER IN PREPARING TRANSPARENCIES.

THE POWER TAKE-OFF ASSEMBLY

UNIT CONCEPT: THE POWER TAKE-OFF ASSEMBLY TRANSFERS POWER TO OPERATE AUXILLARY EQUIPMENT. SERVICING AND MAINTAINING THE POWER TAKE-OFF WILL RESULT IN MINIMIZING SUCH PROBLEMS AS EXCESSIVE EQUIPMENT VIBRATION OR NONTRANSFER OF POWER TO THE AUXILLARY EQUIPMENT.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH EQUIPMENT WITH MALFUNCTIONS IN THE POWER TAKE-OFF, DIAGNOSE THE NATURE OF THE MALFUNCTIONS BY FOLLOWING PROCEDURES DESCRIBED IN THE SERVICE MANUAL.

2. WHEN PROVIDED WITH A POWER TAKE-OFF ASSEMBLY, PERFORM GENERAL MAINTENANCE PROCEDURES RECOMMENDED BY THE MANUFACTURER SUCH AS REPLACING SAFETY SHIELDS AND U-JOINTS.

3. WHEN PROVIDED WITH EQUIPMENT WITH DEFECTS IN THE POWER TAKE-OFF ASSEMBLY AND IN THE DRIVE SHAFT, REMOVE, DISASSEMBLE, INSPECT, SERVICE, REASSEMBLE AND INSTALL THE POWER TAKE-OFF ASSEMBLY BY FOLLOWING THE PROCEDURES IN THE SERVICE MANUAL.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING THE SYMPTOMS THAT MAY INDICATE DEFECTS OR MALADJUSTMENTS IN THE POWER TAKE-OFF ASSEMBLY SUCH AS:
   A. EXCESSIVE VIBRATION
   B. LOSS OF OIL
   C. LACK OF TORQUE
2. COMPONENTS OF THE POWER TAKE-OFF ASSEMBLY
   A. IDENTIFYING THE PARTS OF THE ASSEMBLY
   B. DETERMINING THE FUNCTION OF THE PARTS
   C. TYPES OF POWER TAKE-OFF SYSTEMS
3. DETERMINING THE MAJOR CAUSES OF PROBLEMS IN THE POWER TAKE-OFF ASSEMBLY

4. GENERAL PROCEDURES TO FOLLOW IN LOCATING SPECIFIC DEFECTS IN THE POWER TAKE-OFF ASSEMBLY

5. INSPECTING AND SERVICING THE POWER TAKE-OFF ASSEMBLY AND POWER TAKE-OFF DRIVE SHAFT

   A. GENERAL MAINTENANCE PROCEDURES

      (1) REPLACING SAFETY SHIELDS ON THE POWER TAKE-OFF OR POWER TAKE-OFF DRIVE SHAFT
      (2) LUBRICATING UNIVERSAL JOINTS

   B. INSPECTING AND SERVICING THE POWER TAKE-OFF AND DRIVE SHAFT

      (1) REMOVING THE POWER TAKE-OFF ASSEMBLY
      (2) INSPECTING THE BEARINGS AND SEALS FOR DEFECTS AND REPLACING THEM WHEN NECESSARY
      (3) INSPECTING THE SHAFT AND GEARS FOR DEFECTS AND REPLACING THEM WHEN NECESSARY
      (4) REASSEMBLING AND INSTALLING THE POWER TAKE-OFF ASSEMBLY
      (5) INSPECTING AND REPLACING THE UNIVERSAL JOINTS ON DRIVE SHAFT TO AUXILLARY EQUIPMENT

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE EQUIPMENT WITH DEFECTS IN THE POWER TAKE-OFF ASSEMBLY AND LIST THE SYMPTOMS THEY HAVE OBSERVED. AFTER THE SYMPTOMS HAVE BEEN LISTED, HAVE THE STUDENTS USE SERVICE MANUALS TO LOCATE OR IDENTIFY POTENTIAL DEFECTS IN THE POWER TAKE-OFF ASSEMBLY THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. A. USING EQUIPMENT ON WHICH THE STUDENTS ARE WORKING AND A SERVICE MANUAL, HAVE THE STUDENTS CHECK TO SEE THAT ALL POWER TAKE-OFF SAFETY SHIELDS ARE IN PLACE AND, IF NOT, INSTALL THE SAFETY SHIELDS ACCORDING TO DIRECTIONS IN THE SERVICE MANUAL.

   B. HAVE THE STUDENTS LUBRICATE THE POWER TAKE-OFF DRIVE SHAFT AT APPROPRIATE PLACES.

3. USING POWER TAKE-OFF DRIVE SHAFTS THAT TRANSFER POWER TO AUXILLARY EQUIPMENT, HAVE THE STUDENTS INSPECT THE UNIVERSAL JOINTS FOR DEFECTS AND REPLACE DEFECTIVE UNIVERSAL JOINTS.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN THE SYMPTOMS THAT WERE OBSERVED, AND A SECOND COLUMN SHOULD CONTAIN THE POTENTIAL DEFECTS IN THE POWER TAKE-OFF AND DRIVE SHAFT THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. HAVE THE STUDENTS LUBRICATE THE UNIVERSAL JOINTS ON A POWER TAKE-OFF DRIVE SHAFT AND EVALUATE THE STUDENT CONSIDERING THE TYPE OF LUBRICANT HE SELECTS AND THE DEGREE TO WHICH EXCESSIVE LUBRICANT IS APPLIED.

3. HAVE THE STUDENTS REPLACE A UNIVERSAL JOINT IN THE POWER TAKE-OFF DRIVE SHAFT. EVALUATE THE STUDENT BY CONSIDERING SUCH FACTORS AS THE DEGREE TO WHICH THE JOURNAL FITS INTO THE BEARINGS AND THE FLEXIBILITY BETWEEN THE YOKES.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EQUIPMENT WITH A POWER TAKE-OFF AND POWER TAKE-OFF DRIVE SHAFT

2. VARIOUS UNIVERSAL JOINTS, GEARS, AND SHAFTS SHOWING DEFECTS THAT THE STUDENT MAY ENCOUNTER IN WORKING WITH THE POWER TAKE-OFF AND POWER TAKE-OFF SHAFTS

3. APPROPRIATE TOOLS INCLUDING TORQUE WRENCH, SNAP RING REMOVER, GEAR PULLER, PLIERS, SCREWDRIVERS AND WRENCHES

4. GREASE GUN AND LUBRICANT

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: POWER TRAINS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, PP. 9-1 - 9-7.

   IN COVERING THE VARIOUS TYPES OF POWER TAKE-OFFS, THE AUTHORS ALSO GIVE A BASIC OUTLINE FOR THE TROUBLESHOOTING OF POWER TAKE-OFFS WHICH INCLUDES BOTH POSSIBLE PROBLEMS AND CAUSES. A BRIEF SECTION ALSO COVERS THE UNIVERSAL JOINTS.

2. SERVICE MANUALS FOR THE EQUIPMENT BEING WORKED ON

   THESE PUBLICATIONS WILL PROVIDE THE NEEDED TECHNICAL INFORMATION AND PROCEDURES TO FOLLOW IN REMOVING AND INSTALLING THE POWER TAKE-OFF ASSEMBLY.

3. TRACTOR OPERATION AND DAILY CARE. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION OF VOCATIONAL INSTRUCTIONAL MATERIALS. 1967, PP. 68-74.

THIS PUBLICATION ILLUSTRATES THE OPERATION OF THE POWER TAKE-OFF. ALSO DISCUSSED AND ILLUSTRATED ARE THE VARIOUS TYPES OF POWER TAKE-OFFS AND INSTRUCTIONS FOR CONNECTING AND DISCONNECTING THE POWER TAKE-OFF.

THE STEERING SYSTEM

UNIT CONCEPT: IN ORDER TO PROVIDE EASE IN HANDLING THE EQUIPMENT AND SAFE HANDLING OF EQUIPMENT, CONTINUED MAINTENANCE AND SERVICE WILL BE NEEDED TO AVOID OR CORRECT PROBLEMS SUCH AS HARD STEERING, EXCESSIVE STEERING WHEEL FREE PLAY, OR OIL LEAKAGE.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED EQUIPMENT WITH MALFUNCTIONS IN THE STEERING MECHANISM, CORRECTLY DIAGNOSE THE NATURE OF THE MALFUNCTION BY FOLLOWING PROCEDURES DETAILED IN THE SERVICE MANUAL.
2. GIVEN EQUIPMENT WITH DEFECTS IN THE STEERING MECHANISM, REMOVE, INSPECT, DISASSEMBLE IF NECESSARY, REPAIR OR SERVICE, REASSEMBLE AND INSTALL THE STEERING MECHANISM ACCORDING TO THE DIRECTIONS IN THE SERVICE MANUAL.
3. GIVEN EQUIPMENT WITH A STEERING MECHANISM, ADJUST ALIGNMENT AND TOE-IN ACCORDING TO THE DIRECTIONS IN THE SERVICE MANUAL.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND PROBLBMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE STEERING SYSTEM SUCH AS:
    - A. DIFFICULTY IN TURNING
    - B. EXCESSIVE STEERING WHEEL FREE PLAY
    - C. OIL LEAKAGE
2. COMPONENTS OF THE STEERING SYSTEM
    - A. IDENTIFYING THE PARTS OF THE SYSTEM
    - B. DETERMINING THE FUNCTIONS OF THE PARTS
    - C. TYPES OF STEERING SYSTEMS
        - (1) POWER STEERING
        - (2) MECHANICAL SYSTEMS

D. PRINCIPLES OF STEERING GEAR OPERATION

3. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE STEERING SYSTEM

4. GENERAL TROUBLESHOOTING PROCEDURES FOR LOCATING SPECIFIC DEFECTS IN THE STEERING MECHANISM

5. INSPECTING AND SERVICING THE STEERING MECHANISM

   A. GENERAL MAINTENANCE PROCEDURES FOR THE STEERING MECHANISM

      (1) LUBRICATING THE STEERING MECHANISM
      (2) CHECKING THE FLUID LEVEL IN THE POWER STEERING PUMP AND ADDING FLUID WHEN NECESSARY
      (3) BLEEDING THE AIR FROM THE POWER STEERING SYSTEM ACCORDING TO DIRECTIONS IN THE SERVICE MANUAL
      (4) ADJUST POWER STEERING PUMP BELT TENSION
      (5) RECHECKING THE POWER STEERING SYSTEM FOR LEAKS

   B. INSPECTING AND SERVICING SPECIFIC INTERNAL COMPONENTS OF THE STEERING MECHANISM

      (1) INSPECTING AND REPACKING BEARINGS IN THE STEERING MECHANISM AND ADJUSTING THE BEARING
      (2) INSPECTING AND REPLACING THE SEALS
      (3) REMOVING THE STEERING GEAR FROM THE MECHANICAL STEERING SYSTEM OR THE TORQUE MOTOR FROM THE POWER STEERING SYSTEM
      (4) DISASSEMBLING THE STEERING GEAR FROM THE MECHANICAL SYSTEM, INSPECTING THE COMPONENT PARTS, AND MAKING THE NECESSARY REPLACEMENTS
      (5) REMOVING, INSPECTING, AND REPLACING THE POWER STEERING VALVE
      (6) DISASSEMBLING THE TORQUE MOTOR FROM POWER STEERING SYSTEMS, INSPECTING THE COMPONENT PARTS, AND MAKING THE NECESSARY REPLACEMENTS
      (7) REASSEMBLING AND INSTALLING THE STEERING GEAR ON THE MECHANICAL SYSTEM AND TORQUE MOTOR ON THE POWER STEERING SYSTEM

   C. MAKING ADJUSTMENTS IN THE STEERING ASSEMBLY

      (1) ADJUSTING THE FRONT WHEEL TOE-IN

         (A) MEASURING THE TOE-IN
         (B) ADJUSTING THE TOE-IN ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS

      (2) CHECKING THE FRONT WHEEL TURNING ANGLE

(A) DETERMINING THE TURNING ANGLE
(B) MAKING THE ADJUSTMENT TO OBTAIN THE CORRECT TURNING ANGLE

(3) ADJUSTING THE DRAG LINK SO TO MINIMIZE END-PLAY

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE AND LIST THE SYMPTOMS THEY IDENTIFIED ON EQUIPMENT WHICH HAD MALADJUSTMENTS IN THE STEERING SYSTEM. AFTER THE SYMPTOMS HAVE BEEN LISTED, HAVE THE STUDENTS REFER TO A SERVICE MANUAL TO IDENTIFY POSSIBLE DEFECTS IN THE STEERING SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE OBSERVED SYMPTOMS.

2. USING EQUIPMENT WITH POWER STEERING, HAVE THE STUDENTS CHECK THE LEVEL OF OIL IN THE POWER STEERING PUMP AND BLEED THE AIR FROM THE SYSTEM BY FOLLOWING DIRECTIONS IN THE SERVICE MANUAL.

3. USING EQUIPMENT IN THE SHOP, HAVE THE STUDENTS CHECK THE FRONT WHEEL TURNING ANGLE WITH A TURNING ANGLE PROTRACTOR AND ADJUST THE WORM GEAR STOP SCREWS TO OBTAIN THE CORRECT TURNING ANGLES.

D. EXAMPLES OR PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN THE SYMPTOMS THAT WERE OBSERVED AND THE SECOND COLUMN SHOULD CONTAIN DEFECTS IN THE STEERING SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOM.

2. HAVE THE STUDENTS BLEED AIR FROM THE POWER STEERING SYSTEM ON A GIVEN ITEM OF EQUIPMENT. EVALUATE THE STUDENTS ON THE PROCEDURES THEY FOLLOW AND WHETHER THE FLUID LEVEL DROPS IN THE POWER STEERING PUMP RESERVOIR.

3. HAVE THE STUDENTS LIST THE PROCEDURES TO FOLLOW IN MAKING THE TOE-IN ADJUSTMENT. ALSO PROVIDE A SKETCH SHOWING THE FRONT END OF A TRACTOR AND HAVE THE STUDENTS INDICATE WHAT MEASUREMENTS THEY WOULD NEED TO MAKE.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EQUIPMENT FOR THE STUDENT TO WORK ON

2. JACK AND BLOCKING
3. HYDRAULIC OIL AND GREASE
4. VARIOUS ITEMS FOR THE STUDENTS TO INSPECT FOR DEFECTS SUCH AS SEALS AND BEARINGS
5. CHARTS SHOWING THE VARIOUS TYPES OF STEERING SYSTEMS AND COMPONENT PARTS OF STEERING SYSTEMS
6. APPROPRIATE HAND TOOLS SUCH AS SNAP RING EXPANDER, WRENCHES, SOCKET SET, SCREWDRIVERS, PLIERS, RULERS, HAMMER, PUNCH, WIRE POINTER, TURNING PROTACTOR, AND ALLEN WRENCHES

F. EXAMPLES OF SUPPORTING REFERENCES

1. SERVICE MANUALS FOR THE EQUIPMENT BEING WORKED ON

   THESE PUBLICATIONS WILL PROVIDE THE PROPER TECHNICAL INFORMATION NECESSARY TO SERVICE THE STEERING ASSEMBLY.

THE HYDRAULIC SYSTEM

UNIT CONCEPT: THE MAINTENANCE AND REPAIR OF THE HYDRAULIC SYSTEM COMPONENTS WILL AID IN THE EFFICIENT CONVERSION OF MECHANICAL FORCE INTO HYDRAULIC FLUID POWER FOR THE PERFORMANCE OF VARIOUS FUNCTIONS ON AGRICULTURAL EQUIPMENT. PROPER SERVICE AND MAINTENANCE OF THE HYDRAULIC SYSTEM WILL AID IN AVOIDING PROBLEMS SUCH AS THE SYSTEM OPERATING SLOWLY, FOAMING OF OIL IN THE SYSTEM, OIL LOSS, AND CYLINDER CREEPAGE.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. GIVEN EQUIPMENT WITH MALADJUSTMENTS IN THE HYDRAULIC SYSTEM, CORRECTLY DIAGNOSE THE NATURE OF THE MALFUNCTION FOLLOWING DIRECTIONS IN THE SERVICE MANUAL.

2. PROVIDED EQUIPMENT WITH HYDRAULIC SYSTEMS, CHANGE THE FILTERS IN THE HYDRAULIC SYSTEM, CHANGE THE OIL AND ADD OIL TO THE HYDRAULIC SYSTEM, AND CHECK THE SYSTEM FOR LEAKS BY FOLLOWING PROCEDURES DETAILED IN THE SERVICE MANUAL.

3. PROVIDED EQUIPMENT WITH DEFECTS IN THE HYDRAULIC SYSTEM, REMOVE, DISASSEMBLE IF NECESSARY, REPAIR OR SERVICE, REASSEMBLE, INSTALL, AND ADJUST WHEN NECESSARY ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS THE FOLLOWING COMPONENTS OF THE HYDRAULIC SYSTEM:

   A. HYDRAULIC PUMP

   B. HYDRAULIC CYLINDER

   C. HYDRAULIC VALVES

   D. RESERVOIR AND FILTERS

   E. LINES AND FITTINGS

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE HYDRAULIC SYSTEM SUCH AS:

- A. SLOW SYSTEM OPERATION
- B. OIL LOSS
- C. CYLINDER CREEPAGE

2. COMPONENTS OF THE HYDRAULIC SYSTEM
    - A. IDENTIFYING THE PARTS OF THE SYSTEM
    - B. DETERMINING THE FUNCTIONS OF THE PARTS
    - C. PRINCIPLES OF OPERATION IN THE HYDRAULIC SYSTEM
    - D. TYPES OF HYDRAULIC SYSTEMS
    - E. CHARACTERISTICS OF HYDRAULIC OILS
3. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS IN THE HYDRAULIC SYSTEM
4. GENERAL PROCEDURES FOR TROUBLESHOOTING THE HYDRAULIC SYSTEM FOR DEFECTS AND MALADJUSTMENTS
5. INSPECTING AND SERVICING THE HYDRAULIC SYSTEM
    - A. GENERAL MAINTENANCE PROCEDURES FOR THE HYDRAULIC SYSTEM
        - (1) DETERMINING WHY CLEANLINESS IS SO IMPORTANT WHEN SERVICING THE HYDRAULIC SYSTEM
        - (2) KEEPING THE EXTERNAL SURFACES OF THE HYDRAULIC SYSTEM CLEAN
        - (3) CHANGING FILTERS IN THE HYDRAULIC SYSTEM
        - (4) CHANGING OR ADDING OIL TO THE HYDRAULIC SYSTEM
        - (5) DRAINING THE HYDRAULIC SYSTEM
        - (6) CLEANING AND FLUSHING THE SYSTEM
        - (7) FILLING THE SYSTEM WITH CLEAN OIL
        - (8) CHECKING THE SYSTEM FOR LEAKS AND TIGHTENING LOOSE CONNECTIONS
        - (9) BLEEDING AIR FROM THE SYSTEM ACCORDING TO THE MANUFACTURER'S DIRECTIONS
    - B. INSPECTING AND SERVICING HYDRAULIC LINES AND FITTINGS
        - (1) IDENTIFYING DEFECTIVE HOSES AND TUBING
        - (2) REMOVING DEFECTIVE HOSES AND TUBING
        - (3) CUTTING HOSES AND TUBING TO REPLACE THE DEFECTIVE PARTS
        - (4) INSTALLING THE PROPER HOSE AND TUBE FITTINGS
        - (5) INSTALLING THE HOSES AND TUBING IN THE HYDRAULIC SYSTEM AND TIGHTENING THE CONNECTIONS

C. INSPECTING AND SERVICING HYDRAULIC CYLINDERS

(1) IDENTIFYING AND REMOVING THE DEFECTIVE CYLINDER
(2) DISASSEMBLING THE CYLINDER
(3) INSPECTING AND REPLACING DEFECTIVE PARTS
(4) REPLACING AND INSTALLING O-RINGS
(5) INSTALLING THE SEALS AND PACKING
(6) REASSEMBLING THE CYLINDER
(7) INSTALLING THE CYLINDER
(8) CHECKING THE OPERATION OF THE CYLINDER
(9) BLEEDING REMOTE CYLINDERS

D. INSPECTING AND SERVICING HYDRAULIC PUMPS

(1) REMOVING THE HYDRAULIC PUMP
(2) REPLACING THE HYDRUALIC PUMP
(3) INSTALLING THE HYDRAULIC PUMP

E. INSPECTING AND SERVICING HYDRAULIC VALVES

(1) CHECKING THE OPERATION OF THE HYDRAULIC VALVES
(2) TESTING THE RELIEF VALVE
(3) CLEANING AND REPLACING THE VALVES
(4) ADJUSTING RELIEF VALVE PRESSURE
(5) CHECKING VALVE SPRING TENSION

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE AND LIST THE SYMPTOMS THEY OBSERVED ON EQUIPMENT WHICH HAD MALADJUSTMENTS IN THE HYDRAULIC SYSTEM. AFTER THE SYMPTOMS HAVE BEEN IDENTIFIED, HAVE THE STUDENTS REFER TO A SERVICE MANUAL TO IDENTIFY POSSIBLE DEFECTS IN THE HYDRAULIC SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE OBSERVED SYMPTOMS.

2. USING EQUIPMENT ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS DRAIN THE HYDRAULIC SYSTEM, CLEAN AND FLUSH THE SYSTEM WITH NEW HYDRAULIC OIL, DRAIN THE FLUSHING OIL, AND REFILL THE SYSTEM WITH NEW OIL. BE CERTAIN THAT CLEAN FILTERS HAVE BEEN INSTALLED BEFORE THE NEW OIL IS ADDED.

3. USING THE EQUIPMENT ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS DISASSEMBLE A CYLINDER, REPLACE THE O-RING, REPLACE THE OIL SEAL AND PACKING, AND REASSEMBLE THE CYLINDER.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN THE SYMPTOMS THAT WERE OBSERVED AND THE SECOND COLUMN SHOULD CONTAIN DEFECTS IN THE HYDRUALIC SYSTEM.

2. HAVE THE STUDENTS DRAIN, CLEAN, FLUSH AND REFILL THE HYDRAULIC SYSTEM. EVALUATE THE STUDENT BY THE SEQUENCE IN WHICH THE PROCEDURES ARE PERFORMED, THE MATERIAL HE WOULD USE TO FLUSH THE SYSTEM, ALONG WITH THE PROCEDURES DETAILED IN THE SERVICE MANUAL.

3. DEVELOP A SERIES OF SKETCHES WHICH SHOW THE CORRECT OR INCORRECT INSTALLATION OF HOSES AND TUBING FOR SPECIFIC SITUATIONS. HAVE THE STUDENTS INDICATE WHETHER THE SKETCH REPRESENTS A "RIGHT" OR "WRONG" PROCEDURE. FOR THOSE WHICH REPRESENT A "WRONG" PROCEDURE, HAVE THE STUDENTS DRAW THE "CORRECT" PROCEDURE FOR MAKING THE CONNECTION.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. VARIOUS HYDRAULIC SYSTEMS FOR THE STUDENTS TO WORK ON

2. SPECIALIZED EQUIPMENT RECOMMENDED BY THE MANUFACTURER FOR WORKING ON THE HYDRAULIC SYSTEM INCLUDING TORQUE WRENCH, DIAL INDICATOR, HIGH AND LOW PRESSURE GAUGES, SEAL THIMBLE, HYDRAULIC TESTING UNIT, VALVE SPRING TESTER, TUBING CUTTER FLARING TOOL, TUBE BENDING TOOL.

3. APPROPRIATE COMMON HAND TOOLS NECESSARY FOR SERVICING THE HYDRAULIC SYSTEM SUCH AS WRENCHES, PLIERS, SCREWDRIVERS, FUNNEL, DRAIN PAN.

4. HYDRAULIC OIL AND CLEAN CLOTH

5. EXAMPLES OF DEFECTIVE O-RINGS, SEALS, AND PACKING FOR THE STUDENTS TO INSPECT FOR DEFECTS.

6. CHARTS SHOWING THE COMPONENTS OF THE COMPLETE HYDRAULIC SYSTEM

7. TUBING AND HOSES

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: HYDRAULICS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1972, 170 PAGES.

A COMPLETE DISCUSSION OF THE HYDRAULIC SYSTEM WITH APPROPRIATE ILLUSTRATIONS IS PROVIDED IN THIS PUBLICATION. INCLUDED IS A SECTION ON THE DIAGNOSIS AND TESTING OF HYDRAULIC SYSTEMS.

2. MOBILE HYDRAULICS MANUAL. TROY, MICHIGAN: VICKERS MOBILE HYDRAULIC DIVISION, SPERRY RAND CORPORATION. 1967, PP. 23-35, 61-68, 81-113, 161-165.

   THIS REFERENCE MAY BE MORE BENEFICIAL TO THE TEACHER THAN THE STUDENT IN PROVIDING BACKGROUND INFORMATION ON THE HYDRAULIC SYSTEM. MANY COLORED ILLUSTRATIONS ARE PRESENTED IN THIS PUBLICATION THAT THE TEACHER MAY USE IN DEVELOPING TRANSPARENCIES.

3. SERVICE MANUALS FOR THE EQUIPMENT BEING WORKED ON.

   THESE WILL PROVIDE THE NECESSARY TECHNICAL INFORMATION AND DIRECTIONS NEEDED TO SERVICE THE HYDRAULIC SYSTEM.

4. TRACTOR HYDRAULICS. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION OF VOCATIONAL INSTRUCTIONAL MATERIALS. 45 PAGES.

   A PUBLICATION WHICH COVERS THE HYDRAULIC SYSTEM IN A GENERAL NATURE, THIS PUBLICATION MAY BE BENEFICIAL IN DISCUSSING THE PRINCIPLES OF OPERATION IN HYDRAULIC SYSTEMS.

THE AIR CONDITIONING SYSTEM

UNIT CONCEPT: CONTINUED REPAIR AND SERVICE OF THE AIR CONDITIONING SYSTEM WILL RESULT IN PROVIDING A COMFORTABLE ENVIRONMENT FOR THE OPERATOR WHILE MINIMIZING PROBLEMS SUCH AS A LACK OF COOLING, INTERMITTENT COOLING, OR A NOISY AIR CONDITIONING SYSTEM.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED EQUIPMENT WITH MALADJUSTMENTS IN THE AIR CONDITIONING SYSTEM, TEST THE SYSTEM AND DIAGNOSE THE NATURE OF THE MALFUNCTIONS IN THE SYSTEM BY FOLLOWING PROCEDURES DETAILED IN THE SERVICE MANUAL.
2. PROVIDED EQUIPMENT WITH AN AIR CONDITIONING SYSTEM, INSPECT AND SERVICE THE COMPRESSOR DRIVE BELTS, INSPECT AND TIGHTEN COMPRESSOR BRACKETS AND BRACES, REPLACE HOSE PROTECTIVE MATERIAL AND HOSES, CHECK THE COMPRESSOR OIL LEVEL AND CLEAN AIR DUCTS AND AIR FILTERS ACCORDING TO THE DIRECTIONS IN THE SERVICE MANAUL.
3. PROVIDED EQUIPMENT WITH AN AIR CONDITIONING SYSTEM, REMOVE, REPLACE, AND/OR SERVICE THE FOLLOWING PARTS OF THE AIR CONDITIONING SYSTEM:
   - A. COMPRESSOR
   - B. CONDENSOR
   - C. EVAPORATOR
   - D. CIRCUITS AND VALVES

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND PROBLEMS CAUSED BY DEFECTS AND MALADJUSTMENTS IN THE AIR CONDITIONING SYSTEM SUCH AS:
   - A. LACK OF COOLING
   - B. INTERMITTANT COOLING
   - C. EXCESSIVE NOISE

2. COMPONENTS OF THE AIR CONDITIONING SYSTEM

    A. IDENTIFYING THE PARTS OF THE SYSTEM

    B. DETERMINING THE FUNCTIONS OF THE VARIOUS PARTS

    C. PRINCIPLES OF OPERATION

    D. TYPES OF REFRIGERANTS USED IN THE AIR CONDITIONING SYSTEM

3. DETERMINING THE MAJOR CAUSES OR SOURCES OF PROBLEMS

4. GENERAL TROUBLESHOOTING PROCEDURES FOR LOCATING SPECIFIC DEFECTS

5. INSPECTING AND SERVICING THE AIR CONDITIONING SYSTEM

    A. GENERAL MAINTENANCE PROCEDURES FOR THE AIR CONDITIONING SYSTEM

        (1) VISUALLY INSPECTING THE COMPRESSOR DRIVE BELTS FOR DEFECTS AND TIGHTENING OR REPLACING THE BELT
        (2) TIGHTENING MOUNTING BOLTS AND REPLACING BROKEN BRACKETS AND BRACES
        (3) PROVIDING PROTECTIVE MATERIAL SUCH AS GROMMETS AND RUBBER PADS TO PREVENT CHAFING OR HOSES
        (4) CLEANING DEBRIS FROM THE CONDENSOR COILS AND FROM THE EVAPORATOR PASSAGES
        (5) CHECKING THE COMPRESSOR OIL LEVEL AND ADDING OIL WHEN NECESSARY
        (6) CHECKING THE OPERATION OF THE AIR DUCTS AND LOUVERS
        (7) INSPECTING AND CLEANING THE AIR FILTERS
        (8) CHECKING THE OPERATION OF THE BLOWER MOTOR
        (9) INSPECTING AND TESTING THE SYSTEM FOR LEAKS
        (10) ADDING REFRIGERANT TO THE SYSTEM

    B. INSPECTING AND SERVICING SPECIFIC COMPONENTS OF THE AIR CONDITIONING SYSTEM

        (1) BLEEDING OR DISCHARGING THE SYSTEM
        (2) PROCEDURES FOR REMOVING AND REPLACING THE COMPRESSOR
        (3) PROCEDURES FOR REMOVING AND REPLACING THE EXPANSION VALVE
        (4) PROCEDURES FOR REMOVING AND REPLACING THE EVAPORATOR
        (5) EVACUATING THE AIR CONDITIONING SYSTEM
        (6) CHARGING THE SYSTEM

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS LIST THE SYMPTOMS THEY HAVE OBSERVED ON A MALFUNCTIONING AIR CONDITIONING SYSTEM. AFTER THE SYMPTOMS ARE LISTED, HAVE THE STUDENTS USE A SERVICE MANUAL TO IDENTIFY POTENTIAL DEFECTS THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. HAVE THE STUDENTS INSPECT THE COMPRESSOR BELT FOR FRAYED EDGES OR EXCESSIVE SLACK AND HAVE THE STUDENTS REPLACE THE BELT IF NECESSARY AND ADJUST BELT TENSION.

3. HAVE THE STUDENTS BLEED OR DISCHARGE THE AIR CONDITIONING SYSTEM ON EQUIPMENT BEFORE "OPENING" OR DISCONNECTING ANY LINES OR UNITS IN THE SYSTEM.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN THE SYMPTOMS THAT WERE OBSERVED AND THE SECOND COLUMN SHOULD CONTAIN DEFECTS IN THE AIR CONDITIONING SYSTEM THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYMPTOMS.

2. HAVE THE STUDENTS ADJUST THE COMPRESSOR BELT TENSION. EVALUATE THE STUDENTS ON THE PROCEDURES THEY FOLLOW AND WHETHER THE BELT HAS A 1/2" DEFLECTION.

3. HAVE THE STUDENTS BLEED THE AIR CONDITIONING SYSTEM. EVALUATE THE STUDENTS WITH REGARD TO FOLLOWING THE PROPER PROCEDURES DESCRIBED IN THE SERVICE MANUAL.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. VARIOUS ITEMS OF EQUIPMENT WITH AIR CONDITIONING UNITS FOR THE STUDENTS TO WORK ON

2. APPROPRIATE HAND TOOLS INCLUDING SPECIALIZED EQUIPMENT RECOMMENDED BY THE MANUFACTURER SUCH AS A VACUUM PUMP, CHARGING HOSE, GAUGE AND MANIFOLD SET, LEAK DETECTOR KIT, AND RECHARGING UNIT.

3. APPROPRIATE SMALL HAND TOOLS SUCH AS PLIERS, SCREWDRIVERS, WRENCHES, AND GOGGLES

4. REFRIGERANT TO BE USED IN RECHARGING THE SYSTEM

F. EXAMPLES OR SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: AIR CONDITIONING. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATIONS. 1970, 108 PAGES.

   THIS PUBLICATION COVERS IN DETAIL THE AIR CONDITIONING SYSTEM AND PROVIDES IN DETAIL SECTIONS WHICH COVER THE TROUBLESHOOTING, TESTING, AND DIAGNOSIS OF THE AIR CONDITIONING SYSTEM.

2. SERVICE MANUALS AND OPERATOR'S MANUALS FOR THE EQUIPMENT BEING WORKED ON.

   THESE PUBLICATIONS WILL PROVIDE THE TECHNICAL INFORMATION AND PROCEDURES TO FOLLOW IN REPAIRING AND SERVICING THE AIR CONDITIONING SYSTEM.

WHEELS, TIRES, AND TRACKS

UNIT CONCEPT: PROVIDING PROPER SERVICE AND REPAIR OF THE WHEEL AND/OR TRACK ASSEMBLY ON EQUIPMENT WILL RESULT IN SAFER OPERATING CONDITIONS FOR THE OPERATOR AND LESS LOSS OF "DOWN TIME" DUE TO SUCH PROBLEMS AS THE TRACK RUNNING-OFF ON A CRAWLER, LOSS OF OIL, OR BEARING FAILURE.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED EQUIPMENT WITH MALADJUSTMENTS IN THE WHEEL OR TRACK ASSEMBLY, DIAGNOSE THE NATURE OF THE DEFECTS BY FOLLOWING PROCEDURES IN THE SERVICE MANUAL.

2. PROVIDED EQUIPMENT WITH DEFECTS IN THE WHEEL ASSEMBLY, REMOVE THE WHEEL, REPLACE OR REPACK WHEEL BEARINGS, REPLACE THE SEALS, INSTALL AND ADJUST THE BEARING, AND REPLACE THE WHEEL ACCORDING TO THE DIRECTIONS IN THE SERVICE MANUAL.

3. PROVIDED EQUIPMENT WITH DEFECTS IN THE TRACK AND IDLER ASSEMBLY, REMOVE THE TRACK, REMOVE AND REPLACE IDLER WHEELS, REMOVE AND REPLACE TRACK ROLLERS, AND INSTALL AND ADJUST THE TRACK ACCORDING TO PROCEDURES IN THE SERVICE MANUAL.

B. INSTRUCTIONAL AREAS

1. IDENTIFYING SYMPTOMS AND/OR PROBLEMS THAT MAY INDICATE DEFECTS OR MALADJUSTMENTS IN THE WHEEL OR TRACK ASSEMBLY SUCH AS:
    A. EXCESSIVE VIBRATION
    B. LOSS OF OIL
    C. BEARING NOISE
2. COMPONENTS OF THE WHEEL OR TRACK ASSEMBLY
    A. IDENTIFYING THE PARTS
    B. DETERMINING THEIR FUNCTION
3. DETERMINING THE MAJOR CAUSES OF WHEEL OR TRACK PROBLEMS

4. DIAGNOSING THE NATURE OF THE SPECIFIC DEFECTS IN THE WHEEL OR TRACK ASSEMBLY

5. INSPECTING AND SERVICING THE WHEEL OR TRACK ASSEMBLY

   A. GENERAL MAINTENANCE PROCEDURES FOR THE WHEEL OR TRACK

      (1) CHECKING TIRE PRESSURE
      (2) INFLATING TIRES TO THE DESIRED LEVEL
      (3) LUBRICATING THE TRACK ASSEMBLY
      (4) ADJUSTING TRACK TENSION

   B. INSPECTING AND SERVICING WHEEL BEARINGS AND SEALS

      (1) REMOVING WHEEL BEARINGS AND SEALS
      (2) INSPECTING WHEEL BEARINGS AND SEALS
      (3) REPACKING WHEEL BEARINGS
      (4) REPLACING WHEEL BEARINGS AND SEALS AND INSERTING THE BEARINGS AND SEALS
      (5) INSTALLING THE WHEEL
      (6) ADJUSTING THE WHEEL BEARINGS

   C. INSPECTING AND SERVICING THE TRACK ASSEMBLY

      (1) REMOVING THE TRACK
      (2) INSPECTING THE PINS AND BUSHINGS IN THE TRACKS
      (3) INSPECTING THE FRONT IDLER ASSEMBLY AND REMOVING AND REPLACING THE FRONT IDLER WHEN NECESSARY
      (4) REPLACING OR SERVICING SEALS AND BEARINGS IN THE IDLER
      (5) REMOVING THE TRACK ROLLER ASSEMBLY AND SERVICING OR REPLACING BEARINGS AND SEALS
      (6) INSTALLING THE TRACK ON THE ASSEMBLY
      (7) ADJUSTING TRACK TENSION

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS OBSERVE, THEN LIST THE SYMPTOMS THEY OBSERVED ON EQUIPMENT WHICH HAD MALADJUSTMENTS IN THE WHEEL OR TRACK ASSEMBLY. AFTER THE SYMPTOMS HAVE BEEN LISTED, HAVE THE STUDENTS REFER TO A SERVICE MANUAL TO IDENTIFY POSSIBLE DEFECTS IN THE WHEEL OR TRACK ASSEMBLY.

2. USING EQUIPMENT ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENTS REMOVE THE FRONT WHEEL BEARINGS, REPACK THE BEARINGS, INSTALL THE BEARINGS, AND ADJUST THE BEARINGS.

3. USING TRACK EQUIPMENT ON WHICH THE STUDENTS MAY BE WORKING, HAVE THE STUDENTS ADJUST THE TRACK TENSION.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A MATCHING EXERCISE FOR THE STUDENTS TO COMPLETE. ONE COLUMN SHOULD CONTAIN THE SYMPTOMS THAT WERE OBSERVED AND THE SECOND COLUMN SHOULD CONTAIN DEFECTS IN THE WHEEL OR TRACK ASSEMBLY THAT MAY BE CONTRIBUTING TO THE APPEARANCE OF THE SYSTEM.

2. USING EQUIPMENT ON WHICH THE STUDENTS ARE WORKING, HAVE THE STUDENT CHECK THE TIRE PRESSURE AND ADD OR REMOVE AIR FROM THE TIRE SUCH THAT A SPECIFIED READING IS OBTAINED. EVALUATE THE STUDENT CONSIDERING CLEANLINESS PROCEDURES HE FOLLOWS IN CHECKING AND ADDING AIR TO A TIRE AND THE DEGREE TO WHICH A SPECIFIED TIRE PRESSURE IS OBTAINED.

3. HAVE THE STUDENTS ADJUST TRACK TENSION ACCORDING TO THE SPECIFICATIONS IN THE OPERATOR'S MANUAL.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. EQUIPMENT FOR THE STUDENTS TO WORK ON THAT HAS A WHEEL SYSTEM OR A TRACK SYSTEM

2. APPROPRIATE TOOLS AND EQUIPMENT SUCH AS A SOCKET SET, WRENCHES, PLIERS, SCREWDRIVERS, HOIST, AIR COMPRESSOR, TIRE GAUGE, TORQUE WRENCH, HAMMERS, PUNCH, ALIGNING BAR, BLOCKING AND GREASE GUN.

3. HIGH TEMPERATURE GREASE TO REPACK WHEEL BEARINGS

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: BEARINGS AND SEALS. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATION. 1971, 86 PAGES.

   A COMPREHENSIVE REFERENCE, ALL TYPES OF BEARINGS AND SEALS ARE COVERED INCLUDING A SECTION ON THE DIAGNOSIS OF BEARING FAILURES.

2. SERVICE MANUALS FOR THE EQUIPMENT BEING WORKED ON

   THESE PUBLICATIONS WILL PROVIDE THE PROPER TECHNICAL INFORMATION THAT IS HELPFUL IN SERVICING THE WHEEL BEARINGS AND TRACK ASSEMBLY.

3. TIRES FOR FARM EQUIPMENT. VAS 3031. URBANA, ILLINOIS: VOCATIONAL AGRICULTURAL SERVICE, UNIVERSITY OF ILLINOIS. 1970, 20 PAGES.

FOCUSING STRICTLY ON THE TIRE, THIS PUBLICATION COVERS IN DETAIL THE VARIOUS TYPES OF TIRES USED ON AGRICULTURAL EQUIPMENT, DAMAGE THAT MAY OCCUR TO TIRES, AND A TIRE MAINTENANCE PROGRAM.

4. TRACTOR MAINTENANCE: PRINCIPLES AND PROCEDURES. ATHENS, GEORGIA: ENGINEERING CENTER, AMERICAN ASSOCIATION OF VOCATIONAL INSTRUCTIONAL MATERIALS. 1970, PP. 39-43.

WHILE THIS PUBLICATION CONTAINS A VERY BRIEF SECTION ON THE MAINTENANCE OF TRACTOR TIRES, IT DOES CONTAIN A SECTION ON SERVICING FRONT-WHEEL BEARINGS THAT THE STUDENT WILL FIND EASY TO COMPREHEND.

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II

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ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF AGRICULTURAL EQUIPMENT

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF SPRAYING AND DUSTING APPLICATION EQUIPMENT

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF PLANTING EQUIPMENT

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF TILLAGE EQUIPMENT

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF HARVESTING EQUIPMENT

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT

UNIT CONCEPT: THE PROPER ASSEMBLY, ADJUSTMENT, AND SERVICE OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT BEFORE OR AFTER DELIVERY OF THE EQUIPMENT TO THE CUSTOMER WILL NOT ONLY AID IN EFFICIENT OPERATION OF SUCH EQUIPMENT, BUT IT WILL AID IN DEVELOPING AND MAINTAINING GOOD CUSTOMER-DEALER RELATIONS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED KNOCKED-DOWN LABOR SAVING AND MATERIALS HANDLING EQUIPMENT, INSPECT THE BUNDLES FOR MISSING PARTS AND ASSEMBLE THE VARIOUS TYPES OF SUCH EQUIPMENT ACCORDING TO DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

2. PROVIDED VARIOUS TYPES OF ASSEMBLED LABOR SAVING AND MATERIALS HANDLING EQUIPMENT, MAKE INITIAL ADJUSTMENTS ON THE EQUIPMENT AND PROVIDE PRE-DELIVERY SERVICE ACCORDING TO THE DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

3. PROVIDED VARIOUS TYPES OF ASSEMBLED LABOR SAVING AND MATERIALS HANDLING EQUIPMENT, LOAD, DELIVER, AND UNLOAD ASSEMBLED LABOR SAVING AND MATERIALS HANDLING EQUIPMENT AT THE PROPER CUSTOMER LOCATION WITH NO DAMAGE RESULTING TO THE ASSEMBLED EQUIPMENT.

4. PROVIDED VARIOUS TYPES OF MALFUNCTIONING LABOR SAVING AND MATERALS HANDLING EQUIPMENT IN NEED OF REPAIRS OR SERVICE, MAKE SUCH REPAIRS OR SERVICE ACCORDING TO DIRECTIONS DETAILED IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

B. INSTRUCTIONAL AREAS

1. TYPES OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT USED IN AGRICULTURE

   A. OPERATION OF VARIOUS TYPES OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT SUCH AS:

(1) MANURE SPREADER
(2) LOADER
(3) UTILITY BLADES
(4) WAGONS
(5) ELEVATORS

B. FUNCTION OF VARIOUS COMPONENTS OF THE DIFFERENT TYPES OF MATERIALS HANDLING AND LABOR SAVING EQUIPMENT

2. ASSEMBLING VARIOUS TYPES OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT

A. CHECKING THE ASSEMBLY INSTRUCTIONS FOR ANY SPECIAL PROCEDURES OR TOOLS THAT MAY BE NEEDED

B. LOCATING THE BUNDLES, LAYING OUT THE BUNDLES WHERE THEY WILL BE CONVENIENT, AND OPENING THE BUNDLES

C. CHECKING THE PACKING LIST AGAINST THE PARTS IN THE BUNDLES

D. SEPARATING THE HARDWARE ITEMS INTO CONVENIENT PILES FOR IDENTIFICATION

E. FOLLOWING INSTRUCTIONS IN ASSEMBLING THE VARIOUS TYPES OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT SUCH AS A MANURE SPREADER

(1) ATTACHING SIDES TO THE BOTTOM AND INSTALLING THE FEED SHAFT AND FLARE BOARDS
(2) ATTACHING THE FRONT END GATE, CORNER CASTINGS, CROSS ANGLE, AND CONVEYOR TIGHTENERS
(3) INSTALLING THE AXLE ASSEMBLY AND CHAIN GUIDES
(4) ATTACHING THE HITCH AND JACK
(5) INSTALLING THE FRONT CHAIN GUIDES AND INSTALLING THE CONVEYOR
(6) INSTALLING THE CYLINDER ASSEMBLY AND ATTACHING THE CYLINDER HOOD SHIELDS
(7) INSTALLING THE HOOD ASSEMBLY
(8) INSTALLING THE RATCHET WHEEL ASSEMBLY, THE OUTBOARD BEARING BRACKET ASSEMBLY, GEAR CASE, AND DRIVE CHAIN
(9) INSTALLING THE MAIN DRIVE SHAFT, FEED ROD, AND CENTER BEARING SUPPORT
(10) INSTALLING THE RUBBER RETAINER, FRONT BEARING SUPPORT AND LEVEL SECTOR
(11) INSTALLING THE POWER SHAFT, THE SPROCKET-CLUTCH ASSEMBLY, MAIN DRIVE CHAIN AND FEED CONTROL
(12) INSTALLING THE FRONT CHAIN SHIELDS, SHIELD HANGER AND ATTACHING FIELD ROD, AND GEAR BOX SHIELD ASSEMBLY

        (13) INSTALLING OPTIONAL EQUIPMENT SUCH AS END GATES AND FINE MANURE LITTER PAN
        (14) CHECKING ALL BOLTS FOR TIGHTNESS AND TIGHTENING LOOSE BOLTS

3. PRE-DELIVERY SERVICING OF VARIOUS TYPES OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT SUCH AS A MANURE SPREADER

    A. CHECKING ALL PRESSURE FITTINGS WHEN THE SPREADER IS FULLY ASSEMBLED AND REPLACING DAMAGED FITTINGS

    B. LUBRICATING THE SPREADER AND CLEANING CLOGGED GREASE FITTINGS

    C. TESTING THE OPERATION OF THE MANURE SPREADER CYLINDER AND CONVEYOR

    D. MAKING CHANGES AND ADJUSTMENTS IF NEEDED TO INSURE PROPER AND SMOOTH OPERATION

    E. MAKING INITIAL ADJUSTMENTS ON THE POWER TAKE-OFF MANURE SPREADER

        (1) INITIAL ADJUSTMENT OF THE FEED MECHANISM
        (2) INITIAL ADJUSTMENT OF THE CONVEYOR
        (3) ADJUSTING THE CYLINDER DRIVE CHAIN

4. DELIVERING VARIOUS TYPES OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT

    A. LOADING THE EQUIPMENT OR HITCHING THE EQUIPMENT FOR DELIVERY

    B. CHAINING THE EQUIPMENT TO ELIMINATE DAMAGE DUE TO SHIFTING

    C. UNLOADING THE EQUIPMENT

    D. GIVING THE CUSTOMER INSTRUCTIONS ON THE OPERATION AND MAINTENANCE OF THE EQUIPMENT SUCH AS A POWER TAKE-OFF MANURE SPREADER

        (1) EXPLAINING THE USE OF THE OPERATOR'S INSTRUCTION MANUAL
        (2) EXPLAINING GENERAL OPERATION PROCEDURES FOR THE SPREADER
        (3) EXPLAINING GENERAL MAINTENANCE PROCEDURES FOR THE SPREADER
        (4) EXPLAINING HOW TO MAKE VARIOUS ADJUSTMENTS FOR THE SPREADER
        (5) FILING THE DELIVERY REPORT

5. SERVICING AND/OR REPAIRING THE MATERIALS HANDLING AND LABOR SAVING EQUIPMENT SUCH AS THE POWER TAKE-OFF MANURE SPREADER

    A. IDENTIFYING SYMPTOMS THAT MAY INDICATE PROBLEMS IN THE OPERATION OF THE SPREADER AND DETERMINING THEIR CAUSE(S)

    B. CORRECTING THE CAUSE(S) OF THE PROBLEMS

        (1) INSPECTING THE SPROCKETS AND GEARS FOR EXCESSIVE WEAR AND REPLACING WORN OR DAMAGED SPROCKETS AND GEARS
        (2) INSPECTING THE WEB AND CYLINDER FOR BROKEN OR DAMAGED PARTS AND REPLACING THE DAMAGED PARTS
        (3) REPLACING DAMAGED PARTS IN THE GEAR CASE
        (4) REPLACING DAMAGED UNIVERSAL JOINTS ON THE POWER TAKE-OFF SHAFT

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS ASSEMBLE THE CYLINDER ASSEMBLY TO THE HOOD SHIELDS. THE STUDENTS WILL NEED TO FOLLOW EXACT PROCEDURES DESCRIBED IN THE ASSEMBLY MANUAL.

2. HAVE THE STUDENTS ADJUST THE TENSION OF THE CYLINDER DRIVE CHAIN SUCH THAT THERE IS 1/8" DEFLECTION, OR AS OTHERWISE SPECIFIED IN THE ASSEMBLY AND ADJUSTMENT PROCEDURES.

3. HAVE THE STUDENTS LOAD SEVERAL ITEMS OF LABOR SAVING AND MATERIALS HANDLING EQUIPMENT ON A FLAT BED TRUCK FOR DELIVERY TO SEVERAL CUSTOMERS. THE STUDENTS SHOULD USE CHAINS AND BINDERS TO SECURE THE LOAD.

4. HAVE THE STUDENTS REMOVE AND REPLACE BROKEN CYLINDER DRIVE CHAINS, LINKS, WORN SPROCKETS AND GEARS ON A USED MANURE SPREADER IN NEED OF SERVICE AND REPAIR.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. PRESENT THE STUDENTS WITH A SKETCH OF THE GEAR AND SPROCKET ASSEMBLY FOR THE CYLINDER DRIVE CHAIN. WITH A COLORED PENCIL THE STUDENTS SHOULD TRACE THE APPROPRIATE PATH THE CHAIN SHOULD FOLLOW WHEN INSTALLED ON THE SPROCKET AND GEAR ASSEMBLY. EVALUATE THE STUDENT'S RESPONSE AGAINST THE SKETCH IN THE ASSEMBLY MANUAL.

2. HAVE THE STUDENTS ADJUST THE TENSION OF THE CYLINDER DRIVE CHAIN TO MEET THE SPECIFICATIONS GIVEN IN THE ASSEMBLY MANUAL.

3. HAVE THE STUDENTS CHAIN LABOR SAVING EQUIPMENT ON A FLAT BED TRUCK. EVALUATE THE STUDENTS BY CONSIDERING THE DEGREE OF SLACK IN THE CHAIN(S) WHICH COULD CAUSE SHIFTING, THE PATH OF THE CHAIN AROUND THE EQUIPMENT, AND THE DEGREE OF STRESS ON PARTS OF THE EQUIPMENT WHICH MAY BECOME DAMAGED DUE TO CHAINING.

4. HAVE THE STUDENTS INSPECT A USED MANURE SPREADER IN NEED OF REPAIR OR SERVICE. THE STUDENTS SHOULD LIST THE ITEMS THAT NEED TO BE REMOVED AND REPLACED OR SERVICED. EVALUATE THE STUDENT'S RESPONSE AGAINST THE TEACHER'S JUDGEMENT ON WHETHER CERTAIN PARTS NEED TO BE REPLACED OR SERVICED.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. KNOCKED-DOWN MATERIALS HANDLING AND LABOR SAVING EQUIPMENT FOR THE STUDENT TO ASSEMBLE

2. ASSEMBLY MANUALS AND OPERATOR'S INSTRUCTIONAL MANUALS FOR THE EQUIPMENT BEING WORKED ON

3. APPROPRIATE HAND TOOLS SUCH AS PLIERS, HAMMERS, SCREWDRIVERS, WRENCHES, SOCKET SETS, BLOCKING AND HOISTS

4. GREASE, OIL, AND CLOTH

5. USED EQUIPMENT FOR THE STUDENTS TO SERVICE AND REPAIR

F. EXAMPLES OF SUPPORTING REFERENCES

1. FARM MACHINERY AND EQUIPMENT. NEW YORK, NEW YORK: MC GRAW-HILL BOOK COMPANY. 600 PAGES.

   THIS REFERENCE MAY BE MOST HELPFUL IN DISCUSSING THE VARIOUS COMPONENTS OF THE LABOR SAVING EQUIPMENT AND THEIR OPERATION.

2. SERVICE MANUALS FOR THE MATERIALS HANDLING AND LABOR SAVING EQUIPMENT BEING WORKED ON

   THESE PUBLICATIONS WILL INCLUDE TECHNICAL INFORMATION NECESSARY FOR ASSEMBLING, ADJUSTING, REPAIRING, AND SERVICING MATERIALS HANDLING AND LABOR SAVING EQUIPMENT.

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF SPRAYING AND DUSTING APPLICATION EQUIPMENT

UNIT CONCEPT: THE PROPER ASSEMBLY, ADJUSTMENT, AND SERVICE OF SPRAYING AND DUSTING EQUIPMENT BEFORE OR AFTER DELIVERY OF THE SPRAYING AND DUSTING EQUIPMENT TO THE CUSTOMER WILL NOT ONLY AID IN EFFICIENT OPERATION OF SUCH EQUIPMENT, BUT IT WILL AID IN DEVELOPING AND MAINTAINING GOOD CUSTOMER-DEALER RELATIONS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED KNOCKED-DOWN SPRAYING AND DUSTING EQUIPMENT, INSPECT THE BUNDLES FOR MISSING PARTS AND ASSEMBLE THE VARIOUS TYPES OF SPRAYING AND DUSTING EQUIPMENT ACCORDING TO DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

2. PROVIDED VARIOUS TYPES OF ASSEMBLED SPRAYING AND DUSTING EQUIPMENT, MAKE INITIAL ADJUSTMENTS ON THE EQUIPMENT AND PROVIDE PRE-DELIVERY SERVICE ACCORDING TO THE DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

3. PROVIDED VARIOUS TYPES OF ASSEMBLED SPRAYING AND DUSTING EQUIPMENT, LOAD, DELIVER, AND UNLOAD ASSEMBLED SPRAYING AND DUSTING EQUIPMENT AT THE PROPER CUSTOMER LOCATION WITH NO DAMAGE RESULTING TO THE ASSEMBLED EQUIPMENT.

4. PROVIDED VARIOUS TYPES OF MALFUNCTIONING SPRAYING AND DUSTING EQUIPMENT IN NEED OF MINOR REPAIRS OR SERVICE, MAKE SUCH MINOR REPAIRS AND SERVICE ACCORDING TO THE DIRECTIONS DETAILED IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

B. INSTRUCTIONAL AREAS

1. TYPES OF SPRAYING AND DUSTING EQUIPMENT USED IN AGRICULTURE

    A. OPERATION OF VARIOUS TYPES OF SPRAYING AND DUSTING EQUIPMENT SUCH AS:

   (1) HYDRAULIC SPRAYERS
   (2) HYDRO-PNEUMATIC SPRAYERS
   (3) BLOWERS
   (4) AEROSOL GENERATORS - FOGGING EQUIPMENT
   (5) FIELD AND ORCHARD POWER DUSTERS

B. FUNCTIONS OF VARIOUS COMPONENTS OF SPRAYING AND DUSTING EQUIPMENT

2. ASSEMBLING VARIOUS TYPES OF SPRAYING EQUIPMENT

A. CHECKING THE ASSEMBLY INSTRUCTIONS FOR ANY SPECIAL TOOLS OR PROCEDURES THAT NEED TO BE FOLLOWED

B. LOCATING THE BUNDLES, LAYING OUT THE BUNDLES WHERE THEY WILL BE CONVENIENT, AND OPENING THE BUNDLES

C. CHECKING THE PACKING LIST AGAINST THE PARTS IN THE BUNDLE

D. SEPARATING THE HARDWARE ITEMS INTO CONVENIENT PILES FOR IDENTIFICATION

E. FOLLOWING INSTRUCTIONS IN ASSEMBLING THE VARIOUS TYPES OF SPRAYING AND DUSTING EQUIPMENT SUCH AS A TRAILER SPRAYER

   (1) SETTING THE TANK INTO THE SPRAYER FRAME AND SECURING THE TANK
   (2) INSTALLING THE TANK LEVEL GAUGE
   (3) ATTACHING THE MOUNTING ARMS
   (4) ATTACHING THE PUMP SUPPORT TO THE SUPPORT ANGLE
   (5) INSTALLING THE PUMP KITS
   (6) COMPLETING THE INSTALLATION OF THE CENTER FRAME ASSEMBLY
   (7) INSTALLING THE OUTER BOOMS
   (8) ATTACHING THE SHOCK ABSORBER ASSEMBLY
   (9) ATTACHING THE SUPPORT CHAINS AND LIFT ROPES
   (10) CONNECTING THE BOOM HOSES
   (11) INSTALLING DROPS AND NOZZLES SUCH AS SWEET CORN DROPS, COTTON DROPS, AND FLEXIBLE DROPS
   (12) ATTACHING THE TANK STRAINER

3. PRE-DELIVERY SERVICING OF VARIOUS TYPES OF SPRAYING AND DUSTING EQUIPMENT SUCH AS A TRAILER SPRAYER

A. CHECKING THE APPEARANCE OF THE UNIT

B. LUBRICATING THE TRAILER SPRAYER BOOM HINGE

C. CHECKING THE OPERATION OF THE TRAILER SPRAYER AND MAKING ANY CHANGES OR ADJUSTMENTS

D. MAKING INITIAL ADJUSTMENTS ON THE TRAILER SPRAYER

(1) ADJUSTING THE BOOM SPRING
(2) LEVELING THE BOOM

4. DELIVERING VARIOUS TYPES OF SPRAYING AND DUSTING EQUIPMENT

A. LOADING THE SPRAYER FOR DELIVERY OR ATTACHING THE SPRAYER FOR DELIVERY

B. CHAINING THE SPRAYER WHEN LOADED ON A TRUCK TO ELIMINATE DAMAGE DUE TO SHIFTING

C. UNLOADING THE SPRAYER

D. GIVING THE CUSTOMER INSTRUCTIONS ON THE OPERATION AND MAINTENANCE OF THE TRAILER SPRAYER

(1) EXPLAINING THE USE OF THE OPERATOR'S MANUAL
(2) EXPLAINING GENERAL OPERATION PROCEDURES OF THE SPRAYER AND SAFETY PRECAUTIONS ON USING AGRICULTURAL CHEMICALS
(3) EXPLAINING GENERAL MAINTENANCE PROCEDURES FOR THE SPRAYER
(4) EXPLAINING THE VARIOUS ADJUSTMENTS TO BE MADE ON THE SPRAYER
(5) FILING THE DELIVERY REPORT

5. SERVICING AND/OR REPAIRING THE TRAILER SPRAYER

A. IDENTIFYING SYMPTOMS THAT MAY INDICATE PROBLEMS IN THE SPRAYER AND THE CAUSE(S)

B. CORRECTING THE CAUSES OF THE PROBLEMS

(1) REMOVING, CLEANING, AND/OR REPLACING NOZZLES
(2) REMOVING, CLEANING, AND/OR REPLACING HOSES AND STRAINERS
(3) REMOVING AND REPLACING THE SHIMS IN THE PUMP OR REPLACING THE PUMP

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS SET THE SPRAYER TANK INTO THE SPRAYER FRAME AND SECURE THE TANK WITH THE TANK STRAPS. THE STUDENTS WILL NEED TO BE SURE THE TANK IS INSTALLED IN THE PROPER DIRECTION.

2. HAVE THE STUDENTS LEVEL THE OUTER BOOM SECTIONS WITH THE CENTER BOOM SECTIONS BY ADJUSTING THE EYE BOLTS ON THE ENDS OF THE BOOM SUPPORT CHAINS.

3. HAVE THE STUDENTS LOAD A SPRAYER ON A TRUCK FOR DELIVERY. THE STUDENTS SHOULD SECURE THE SPRAYER BY USING CHAINS AND BINDERS.

4. HAVE THE STUDENTS SERVICE AN OLDER SPRAYER IN NEED OF SERVICE. THE STUDENTS SHOULD REMOVE, CLEAN, AND REPLACE NOZZLES WHEN NECESSARY.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A SKETCH WHICH SHOWS THE SPRAYER TANK SETTING IN THE SPRAYER FRAME. HAVE THE STUDENTS INDICATE WHETHER THE TANK IS OR IS NOT INSTALLED IN THE PROPER POSITION. IF THE TANK IS NOT INSTALLED IN THE PROPER POSITION, HAVE THE STUDENTS INDICATE THE CHANGES THAT ARE NEEDED.

2. HAVE THE STUDENTS LEVEL THE OUTER BOOMS ON A TRAILER SPRAYER. THE OUTER BOOMS SHOULD BE LEVEL WITH THE CENTER BOOM.

3. HAVE THE STUDENTS CHAIN A SPRAYER ON A FLAT BED TRUCK. EVALUATE THE STUDENTS BY CONSIDERING THE SLACK IN THE CHAIN(S) WHICH COULD RESULT IN SHIFTING, THE PATH OF THE CHAINS AROUND THE SPRAYER, AND THE DEGREE OF STRESS ON PARTS OF THE SPRAYER WHICH MAY BE DAMAGED DUE TO CHAINING.

4. HAVE THE STUDENTS REPACK THE WHEEL BEARINGS ON A TRAILER SPRAYER. EVALUATE THE STUDENTS BY CONSIDERING THE TYPE OF GREASE USED, THE DEGREE TO WHICH THE OLD GREASE IS REMOVED OR FORCED OUT, THE AMOUNT OF FILL WITH THE NEW GREASE, AND THE REMOVAL OF EXCESS GREASE FROM THE WHEEL BEARING.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. KNOCKED-DOWN SPRAYING AND/OR DUSTING EQUIPMENT FOR THE STUDENTS TO WORK ON.

2. SERVICE MANUALS AND OPERATOR'S INSTRUCTIONAL MANUALS FOR THE STUDENTS TO USE.

3. APPROPRIATE HAND AND POWER TOOLS NEEED TO SET UP THE SPRAYING AND DUSTING EQUIPMENT TO MAKE INITIAL ADJUSTMENTS AND TO SERVICE THE EQUIPMENT SUCH AS WRENCHES, SCREWDRIVERS, PLIERS, SOCKET SET, BINDERS, AND CHAINS.

4. GREASE AND CLOTH

5. OLDER SPRAYING AND DUSTING EQUIPMENT IN NEED OF SERVICE OR REPAIR

F. EXAMPLES OF SUPPORTING REFERENCES

1. FUNDAMENTALS OF SERVICE: MOWING AND SPRAYING EQUIPMENT. MOLINE, ILLINOIS: JOHN DEERE SERVICE PUBLICATION. 1971, PP. 23-34.

   THIS PUBLICATION FOCUSES UPON THE VARIOUS TYPES OF SPRAY NOZZLES, THE COMPONENTS OF THE NOZZLE AND VARIOUS SPRAY PATTERNS. INCLUDED IS A BRIEF SECTION ON NOZZLE PROBLEMS AND SERVICE OF NOZZLES.

2. SERVICE MANUALS AND OPERATOR'S INSTRUCTIONAL MANUALS FOR SPRAYING AND DUSTING EQUIPMENT BEING WORKED ON.

   THESE PUBLICATIONS WILL INCLUDE TECHNICAL INFORMATION NECESSARY FOR ASSEMBLING, ADJUSTING, REPAIRING AND SERVICING SPRAYING AND DUSTING EQUIPMENT.

3. TECHNICAL MANUAL: ORCHARD AND ROW CROP AIR SPRAYERS. ASHLAND, OHIO: THE F.E. MYERS AND BROTHERS CO. 1964, 100 PAGES.

   THIS PUBLICATION MAY BE MOST HELPFUL IN DISCUSSING THE VARIOUS TYPES OF SPRAYING AND DUSTING EQUIPMENT AND THE OPERATION OF THE COMPONENTS OF AIR SPRAYERS.

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF PLANTING EQUIPMENT

UNIT CONCEPT: THE PROPER ASSEMBLY, ADJUSTMENT AND SERVICE OF PLANTING EQUIPMENT BEFORE OR AFTER DELIVERY OF THE PLANTING EQUIPMENT TO THE CUSTOMER WILL NOT ONLY AID IN EFFICIENT OPERATION OF SUCH EQUIPMENT, BUT IT WILL AID IN DEVELOPING AND MAINTAINING GOOD CUSTOMER-DEALER RELATIONS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. WHEN PROVIDED WITH KNOCKED-DOWN PLANTING EQUIPMENT, INSPECT THE BUNDLES FOR MISSING PARTS AND ASSEMBLE THE VARIOUS TYPES OF PLANTING EQUIPMENT ACCORDING TO DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.
2. WHEN PROVIDED WITH VARIOUS TYPES OF ASSEMBLED PLANTING EQUIPMENT, MAKE INITIAL ADJUSTMENTS ON THE EQUIPMENT AND PROVIDE PRE-DELIVERY SERVICE ACCORDING TO THE DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.
3. WHEN PROVIDED WITH VARIOUS TYPES OF ASSEMBLED PLANTING EQUIPMENT, LOAD, DELIVER AND UNLOAD ASSEMBLED PLANTING EQUIPMENT AT THE PROPER CUSTOMER LOCATION WITH NO DAMAGE RESULTING TO THE ASSEMBLED EQUIPMENT.
4. WHEN PROVIDED WITH VARIOUS TYPES OF MALFUNCTIONING PLANTING EQUIPMENT IN NEED OF MINOR REPAIRS OR SERVICE, MAKE SUCH MINOR REPAIRS AND SERVICE ACCORDING TO DIRECTIONS DETAILED IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

B. INSTRUCTIONAL AREAS

1. TYPES OF PLANTING EQUIPMENT USED IN AGRICULTURE
   - A. OPERATION OF VARIOUS TYPES OF PLANTING EQUIPMENT SUCH AS:
     - (1) GRAIN DRILLS
     - (2) ROW CROP PLANTERS SUCH AS CORN, COTTON, POTATO AND PEANUT PLANTERS
     - (3) BROADCAST SEEDERS
     - (4) PLANT-SETTING EQUIPMENT

B. FUNCTIONS OF VARIOUS COMPONENTS OF THE DIFFERENT TYPES OF PLANTING EQUIPMENT

2. ASSEMBLING VARIOUS TYPES OF PLANTING EQUIPMENT

A. CHECKING THE ASSEMBLY INSTRUCTIONS FOR ANY SPECIAL PROCEDURES OR TOOLS THAT MAY BE NEEDED

B. LOCATING THE BUNDLES, LAYING OUT THE BUNDLES WHERE THEY WILL BE CONVENIENT, AND OPENING THE BUNDLES

C. CHECKING THE PACKING LIST AGAINST THE PARTS IN THE BUNDLES

D. SEPARATING THE HARDWARE ITEMS INTO CONVENIENT PILES FOR IDENTIFICATION

E. FOLLOWING INSTRUCTIONS IN ASSEMBLING THE VARIOUS TYPES OF PLANTING EQUIPMENT SUCH AS A FOUR-ROW CORN PLANTER

(1) ASSEMBLING THE HITCH TO THE CROSS PIPE ASSEMBLY
(2) MOUNTING THE TIRE AND TUBE ON THE WHEEL RIM, INFLATING THE TIRE TO THE PROPER PRESSURE, AND MOUNTING THE CARRIER WHEELS ON THE AXLE ASSEMBLY
(3) INSTALLING THE DRIVE CHAIN
(4) INSTALLING THE CABLE SHIELD AND CABLE
(5) INSTALLING THE OPENER UNITS AND CHECKING THEIR ALIGNMENT
(6) ATTACHING THE PRESS WHEELS
(7) ATTACHING THE SEED CAN
(8) ATTACHING THE MARKERS
(9) ATTACHING EXTRA AND OPTIONAL EQUIPMENT SUCH AS HYDRAULIC LIFTS, SPOON COVERS, PRE-EMERGENCE SPRAY ATTACHMENT, GRANULAR INSECTICIDE ATTACHMENT
(10) CHECKING ALL BOLTS FOR TIGHTNESS AND TIGHTENING ANY CONNECTIONS THAT HAVE NOT BEEN TIGHTENED

3. PRE-DELIVERY SERVICING OF VARIOUS TYPES OF PLANTING EQUIPMENT SUCH AS A FOUR-ROW CORN PLANTER

A. CHECKING ALL PRESSURE FITTINGS WHEN THE PLANTER IS FULLY ASSEMBLED AND REPLACING DAMAGED FITTINGS

B. LUBRICATING THE PLANTER AND CLEANING ANY CLOGGED FITTINGS

C. APPLYING A GOOD LIGHT GRADE OF OIL ON PLANTER UNIT IDLER ROLLERS, FERTILIZER IDLER ROLLERS, MARKER PULLEYS, AND FERTILIZER CHAIN ROLLERS

D. TESTING THE PLANTER'S OPERATION AND CHECKING THE PLANTER SEED AND VALVE SHAFTS, TIMING GEARS, SEED CANS, AND DRIVE SHAFTS FOR ALIGNMENT AND SMOOTH OPERATION

E. MAKING CHANGES AND ADJUSTMENTS, IF NEEDED, TO INSURE PROPER ALIGNMENT AND SMOOTH OPERATION

F. MAKING INITIAL ADJUSTMENTS ON THE FOUR-ROW CORN PLANTER

(1) INITIAL ADJUSTMENT OF THE CLUSTER GEARS FOR PLANTING RATE
(2) INITIAL ADJUSTMENT OF ROW SPACING
(3) INITIAL ADJUSTMENT OF PLANTING DEPTH
(4) INITIAL ADJUSTMENT OF MARKERS
(5) INSERTING SEED PLATES
(6) ADJUSTING FERTILIZER PLACEMENT

4. DELIVERING VARIOUS TYPES OF PLANTING EQUIPMENT TO THE CUSTOMER

A. LOADING THE PLANTER ON THE TRUCK OR TRAILER AND ARRANGING THE EQUIPMENT FOR EASE IN DELIVERING

B. CHAINING THE PLANTER TO ELIMINATE DAMAGE DUE TO SHIFTING WHILE TRAVELING

C. UNLOADING THE PLANTER

D. GIVING THE CUSTOMER INSTRUCTIONS ON THE OPERATION AND MAINTENANCE OF THE FOUR-ROW CORN PLANTER

(1) EXPLAINING THE USE OF THE OPERATOR'S INSTRUCTION MANUAL
(2) EXPLAINING GENERAL OPERATION PROCEDURES FOR THE FOUR-ROW CORN PLANTER
(3) EXPLAINING GENERAL MAINTENANCE PROCEDURES FOR THE FOUR-ROW CORN PLANTER
(4) EXPLAINING HOW TO MAKE VARIOUS ADJUSTMENTS FOR THE FOUR-ROW CORN PLANTER
(5) FILING THE DELIVERY REPORT

5. SERVICING AND/OR REPAIRING THE FOUR-ROW CORN PLANTER

A. IDENTIFYING SYMPTOMS THAT MAY BE INDICATIVE OF PROBLEMS IN THE OPERATION OF THE PLANTER

B. DETERMINING WHAT IS CAUSING THE PROBLEM(S)

C. CORRECTING THE CAUSE(S) OF THE PROBLEMS

(1) INSPECTING THE SPROCKETS AND GEARS FOR EXCESSIVE WEAR AND REPLACING WORN OR DAMAGED SPROCKETS AND GEARS AND TIMING THE PLANTER
(2) INSPECTING THE OPENERS AND REPLACING SEALS AND BEARINGS WHEN NECESSARY
(3) INSPECTING FOR BROKEN PARTS ON OTHER ASSEMBLIES OF THE FOUR-ROW CORN PLANTER AND REPLACING THE BROKEN PARTS

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS ASSEMBLE THE IDLER ASSEMBLY OF A FOUR-ROW CORN PLANTER TO THE AXLE ARM AND INSTALL THE DRIVE CHAIN BEING SURE TO INSTALL THE DRIVE CHAIN WITH THE HOOK END OF THE CHAIN LINKS TO THE OUTSIDE AND POINTING FORWARD IN THE DIRECTION OF ROTATION.

2. HAVE THE STUDENTS CHANGE THE ROW SPACING ON A FOUR-ROW CORN PLANTER FORM 40" TO 36" ROW SPACINGS BY LOOSENING THE PARELLEL LINE BRACKETS, REMOVING THE COTTER KEYS FROM THE DRIVE SOCKETS, AND SLIDING THE PLANTER UNITS TO THE 36" ROW SPACING.

3. HAVE THE STUDENTS LOAD SEVERAL ITEMS OF PLANTING EQUIPMENT ON A TRUCK TO BE DELIVERED TO SEVERAL CUSTOMERS. THE STUDENTS SHOULD LOAD THE EQUIPMENT IN THE REVERSE ORDER IN WHICH IT IS TO BE DELIVERED AND CHAINED SO THERE IS NO SHIFTING OF THE LOAD.

4. HAVE THE STUDENTS REMOVE AND REPLACE WORN RING AND PINION GEARS ON A FOUR-ROW CORN PLANTER. IN REPLACING THE TWO GEARS, THE STUDENTS WILL NEED TO TIME THE TWO GEARS.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A SKETCH WHICH SHOWS THE IDLER ASSEMBLY ON THE FOUR-ROW CORN PLANTER ATTACHED TO THE AXLE ARM, THE THROW OUT CLUTCH SPROCKET, THE DRIVE SPROCKET, AND THE DIRECTION OF TRAVEL OF THE DRIVE SPROCKET. HAVE THE STUDENTS TRACE THE PATTERN IN WHICH THE DRIVE CHAIN SHOULD BE INSTALLED WITH A COLORED PENCIL. IN ADDITION, HAVE THE STUDENTS DRAW A SKETCH OF ONE LINK AS IT WOULD APPEAR IN A PROPERLY INSTALLED DRIVE CHAIN AND WHERE THE SKETCH OF THE LINK WOULD APPEAR ON THE DRIVE CHAIN. EVALUATE THE STUDENT BY CONSIDERING WHETHER THE PATH OF THE DRIVE CHAIN IS CORRECT AND WHETHER THE SKETCH OF THE LINK HAS THE HOOK ENDS TO THE OUTSIDE AND POINTING FORWARD IN THE DIRECTION OF ROTATION.

2. HAVE THE STUDENTS ADJUST THE DEPTH OF THE RUNNER ON A FOUR-ROW CORN PLANTER TO 2 1/2" FOR ALL RUNNERS. EVALUATE THE STUDENTS BY CONSIDERING WHETHER A UNIFORM DEPTH OF 2 1/2" (± 1/8") IS OBTAINED.

3. DEVELOP A SKETCH WHICH SHOWS A FOUR-ROW CORN PLANTER ON A FLAT BED TRUCK. HAVE THE STUDENTS USE A COLORED PENCIL TO INDICATE THE PATH THEY WOULD FOLLOW WITH CHAIN(S) WHEN CHAINING THE PLANTER AND WHERE THEY WOULD USE BINDERS TO PREVENT SHIFTING.

4. HAVE THE STUDENTS LIST THE PROCEDURE THEY WOULD FOLLOW TO CHANGE SEED PLATES IN THE FOUR-ROW CORN PLANTER. EVALUATE THE STUDENT BY CONSIDERING WHETHER THEIR PROCEDURE CORRESPONDS WITH THE PROCEDURE IN THE OPERATOR'S INSTRUCTION MANUAL.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. KNOCKED-DOWN PLANTING EQUIPMENT FOR THE STUDENTS TO ASSEMBLE

2. SERVICE MANUALS, OPERATOR'S INSTRUCTION MANUAL, AND ASSEMBLY INSTRUCTIONS FOR THE EQUIPMENT BEING WORKED ON

3. APPROPRIATE HAND TOOLS NEEDED TO SET UP THE EQUIPMENT AND ADJUST AND SERVICE THE PLANTING EQUIPMENT. SOME OF THE TOOLS REQUIRED ARE PLIERS, SCREWDRIVERS, HAMMERS, WRENCHES, SOCKET SETS, BLOCKING, CHAINS AND BINDERS.

4. GREASE, OIL, CLOTH, GREASE GUN AND OIL CAN

5. OLDER PLANTING EQUIPMENT IN NEED OF REPAIR AND SERVICE

F. EXAMPLES OF SUPPORTING REFERENCES

1. FARM MACHINERY AND EQUIPMENT. NEW YORK, NEW YORK: MC GRAW-HILL BOOK COMPANY. 600 PAGES.

   THIS PUBLICATION COVERS, IN A GENERAL MANNER, ROW-CROP, BROADCAST-CROP AND GRAIN-DRILL PLANTING EQUIPMENT. ILLUSTRATIONS IN THE PUBLICATION ARE HELPFUL IN EXPLAINING THE OPERATION AND FUNCTION OF VARIOUS COMPONENTS OF THE PLANTING EQUIPMENT.

2. MACHINES FOR POWER FARMING. NEW YORK, NEW YORK: JOHN WILEY AND SONS, INC.

A GENERAL OVERVIEW OF ROW-CROP PLANTERS AND GRAIN DRILLS IS PRESENTED IN THE PUBLICATION. IT MAY BE MOST HELPFUL TO THE STUDENTS WHEN DISCUSSING THE VARIOUS TYPES OF PLANTERS AND THE FUNCTION OF THEIR COMPONENTS.

3. SERVICE MANUALS AND OPERATOR'S INSTRUCTION MANUALS FOR THE PLANTING EQUIPMENT BEING WORKED ON

THESE PUBLICATIONS WILL INCLUDE TECHNICAL INFORMATION NECESSARY FOR ASSEMBLING, ADJUSTING, REPAIRING AND SERVICING PLANTING EQUIPMENT.

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF TILLAGE EQUIPMENT

UNIT CONCEPT: THE PROPER ASSEMBLY, ADJUSTMENT, AND SERVICE OF TILLAGE EQUIPMENT BEFORE OR AFTER DELIVERY OF THE TILLAGE EQUIPMENT TO THE CUSTOMER WILL NOT ONLY AID IN EFFICIENT OPERATION OF SUCH EQUIPMENT, BUT IT WILL AID IN DEVELOPING AND MAINTAINING GOOD CUSTOMER-DEALER RELATIONS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED KNOCKED-DOWN TILLAGE EQUIPMENT, INSPECT THE BUNDLES FOR MISSING PARTS AND ASSEMBLE THE VARIOUS TYPES OF TILLAGE EQUIPMENT ACCORDING TO DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.
2. PROVIDED VARIOUS TYPES OF ASSEMBLED TILLAGE EQUIPMENT, MAKE INITIAL ADJUSTMENTS ON THE EQUIPMENT AND PROVIDE PRE-DELIVERY SERVICE ACCORDING TO THE DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.
3. PROVIDED VARIOUS TYPES OF ASSEMBLED TILLAGE EQUIPMENT, LOAD, DELIVER, AND UNLOAD ASSEMBLED TILLAGE EQUIPMENT AT THE PROPER CUSTOMER LOCATION WITH NO DAMAGE RESULTING TO THE ASSEMBLED EQUIPMENT.
4. PROVIDED VARIOUS TYPES OF MALFUNCTIONING TILLAGE EQUIPMENT IN NEED OF REPAIRS OR SERVICE, MAKE SUCH MINOR REPAIRS AND SERVICE ACCORDING TO DIRECTIONS DETAILED IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

B. INSTRUCTIONAL AREAS

1. TYPES OF TILLAGE EQUIPMENT USED IN AGRICULTURE

   A. OPERATION OF VARIOUS TYPES OF TILLAGE EQUIPMENT SUCH AS:

      (1) PLOWS
      (2) HARROWS
      (3) ROTARY HOE
      (4) DISKS
      (5) COMPACTORS AND LAND LEVELERS
      (6) CULTIVATORS
      (7) OTHER

B. FUNCTIONS OF VARIOUS COMPONENTS OF DIFFERENT TYPES OF TILLAGE EQUIPMENT

2. ASSEMBLING VARIOUS TYPES OF TILLAGE EQUIPMENT

A. CHECKING THE ASSEMBLY INSTRUCTIONS FOR ANY SPECIAL PROCEDURES AND TOOLS NEEDED

B. LOCATING THE BUNDLES, LAYING OUT THE BUNDLES WHERE THEY WILL BE CONVENIENT, AND OPENING THE BUNDLES

C. CHECKING THE PACKING LIST AGAINST THE PARTS IN THE BUNDLE

D. SEPARATING THE HARDWARE ITEMS INTO PILES FOR IDENTIFICATION

E. FOLLOWING INSTRUCTIONS IN ASSEMBLING THE VARIOUS TYPES OF TILLAGE EQUIPMENT SUCH AS A SEVEN-BOTTOM PLOW

(1) ASSEMBLING THE FRAME AND STANDARDS
(2) ATTACHING THE HITCH
(3) ASSEMBLING AND ATTACHING THE REAR AXLE AND WHEEL
(4) ASSEMBLING AND ATTACHING THE FRONT FURROW AXLE AND WHEEL
(5) ATTACHING THE PIVOT ARM, CYLINDER SUPPORT AND STEERING AND LIFT RODS
(6) ATTACHING THE PLOW BOTTOMS AND LANDSIDES
(7) LINING UP THE PLOW BOTTOMS AND ADJUSTING THE MOLDBOARD BRACE
(8) INSTALLING THE COULTERS
(9) ATTACHING THE GAUGE WHEEL
(10) ATTACHING THE SCREW JACK AND TRANSPORT WHEEL
(11) ATTACHING OPTIONAL ITEMS SUCH AS JOINTERS, ROOT CUTTERS, AND TRASH BOARDS
(12) RECHECKING ALL BOLTS AND CONNECTIONS FOR TIGHTNESS

3. PRE-DELIVERY SERVICING OF VARIOUS TYPES OF TILLAGE EQUIPMENT SUCH AS A SEVEN-BOTTOM PLOW

A. CHECKING ALL PRESSURE FITTINGS WHEN THE PLOW IS FULLY ASSEMBLED AND REPLACING DAMAGED FITTINGS

B. LUBRICATING THE PLOW AND REPLACING DAMAGED FITTINGS

C. TESTING THE OPERATION OF THE PLOW

D. MAKING CHANGES AND ADJUSTMENTS IF NEEDED TO INSURE PROPER OPERATION

4. DELIVERING VARIOUS TYPES OF TILLAGE EQUIPMENT TO THE CUSTOMER

   A. LOADING THE PLOW ON THE TRUCK OR TRAILER AND ARRANGING THE EQUIPMENT FOR EASE IN DELIVERING

   B. CHAINING THE PLOW TO ELIMINATE DAMAGE DUE TO SHIFTING WHILE HAULING

   C. UNLOADING THE PLOW

   D. GIVING THE CUSTOMER INSTRUCTIONS ON THE OPERATION AND MAINTENANCE OF THE PLOW

      (1) EXPLAINING THE USE OF THE OPERATOR'S MANUAL
      (2) EXPLAINING GENERAL OPERATION PROCEDURES FOR THE PLOW
      (3) EXPLAINING GENERAL MAINTENANCE PROCEDURES FOR THE PLOW
      (4) EXPLAINING HOW TO MAKE VARIOUS ADJUSTMENTS ON THE PLOW
      (5) FILING THE DELIVERY REPORT

5. SERVICING AND/OR REPAIRING THE SEVEN-BOTTOM PLOW

   A. IDENTIFYING SYMPTOMS THAT MAY INDICATE PROBLEMS IN THE OPERATION OF THE PLOW

   B. DETERMINING WHAT IS CAUSING THE PROBLEM

   C. CORRECTING THE CAUSE(S) OF THE PROBLEMS

      (1) INSPECTING AND REPLACING DAMAGED OR WORN OUT PLOW SHARES AND COULTERS
      (2) ADJUSTING THE HITCH BEARING
      (3) REPACKING OR REPLACING WHEEL BEARINGS
      (4) ADJUSTING THE HEIGHT OF THE COULTERS
      (5) CONVERTING FROM A SEVEN-BOTTOM TO A SIX-BOTTOM PLOW
      (6) INSPECTING FOR BROKEN PARTS AND REPLACING THE BROKEN PARTS
      (7) ADJUSTING THE SAFETY TRIP RESISTANCE

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS LINE UP THE PLOW BOTTOMS AND MAKE ADJUSTMENTS WHEN NEEDED BY ADJUSTING THE MOLDBOARD BRACE.

2. HAVE THE STUDENTS CHECK ALL PRESSURE FITTINGS WHEN THE PLOW HAS BEEN ASSEMBLED, REPLACE ANY DAMAGED FITTINGS, AND GREASE THE PLOW.

3. HAVE THE STUDENTS LOAD SEVERAL ITEMS OF TILLAGE EQUIPMENT ON A TRUCK FOR DELIVERY TO SEVERAL CUSTOMERS. THE STUDENTS SHOULD LOAD THE EQUIPMENT IN THE REVERSE ORDER IN WHICH IT IS TO BE DELIVERED AND CHAIN THE TILLAGE EQUIPMENT WITH CHAINS AND BINDERS.

4. HAVE THE STUDENTS REMOVE AND REPLACE PLOW SHARES.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. PROVIDED A SKETCH OF A PLOW, HAVE THE STUDENTS INDICATE WHAT MEASUREMENTS THEY WOULD TAKE TO DETERMINE IF THE PLOW BOTTOMS ARE LINED UP. ALSO HAVE THE STUDENT INDICATE WHAT ADJUSTMENTS HE WOULD MAKE IF THE PLOW BOTTOMS ARE NOT LINED UP. EVALUATE THE STUDENT'S AMSWER AGAINST THE PROCEDURES DETAILED IN THE OPERATOR'S OR ASSEMBLY MANUAL.

2. HAVE THE STUDENTS ADJUST THE REAR WHEEL ON THE PLOW SO THAT IT IS 1 - 1 1/4" AWAY FROM THE FURROW WALL.

3. HAVE THE STUDENTS LOAD EQUIPMENT ON A TRAILER OR TRUCK AND CHAIN THE EQUIPMENT USING CHAINS AND BINDERS SO THERE WILL BE NO SHIFTING OF THE LOAD.

4. HAVE THE STUDENTS LIST THE PROCEDURES FOR ADJUSTING THE HITCH BEARING. CHECK THE STUDENTS ANSWER AGAINST THE PROCEDURES IN THE SERVICE MANUAL.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. KNOCKED-DOWN EQUIPMENT AND SERVICE MANUALS FOR THE STUDENT TO ASSEMBLE

2. APPROPRIATE HAND AND POWER TOOLS NEEDED TO SET-UP THE EQUIPMENT AND TO ADJUST AND SERVICE THE EQUIPMENT SUCH AS WRENCHES, SOCKET SETS, HAMMERS, PLIERS, SCREWDRIVERS, BLOCKING, HOIST, CHAINS, AND BINDERS.

3. GREASE

4. OLDER TILLAGE EQUIPMENT IN NEED OF SERVICE AND REPAIR

5. TRUCK OR TRAILER

F. EXAMPLES OF SUPPORTING REFERENCES

1. ASSEMBLY MANUALS AND OPERATOR'S INSTRUCTION MANUALS FOR THE TILLAGE EQUIPMENT BEING WORKED ON.

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THESE PUBLICATIONS WILL INCLUDE TECHNICAL INFORMATION NEEDED FOR ASSEMBLING, ADJUSTING, SERVICING, AND REPAIRING THE TILLAGE EQUIPMENT.

ASSEMBLY, ADJUSTMENT, REPAIR AND/OR SERVICE OF HARVESTING EQUIPMENT

UNIT CONCEPT: THE PROPER ASSEMBLY, ADJUSTMENT AND SERVICE OF HARVESTING EQUIPMENT BEFORE OR AFTER DELIVERY OF THE HARVESTING EQUIPMENT TO THE CUSTOMER WILL NOT ONLY AID IN EFFICIENT OPERATION OF SUCH EQUIPMENT, BUT IT WILL AID IN DEVELOPING AND MAINTAINING GOOD CUSTOMER-DEALER RELATIONS.

A. STUDENT PERFORMANCE OBJECTIVES

THE STUDENT SHOULD BE ABLE TO:

1. PROVIDED KNOCKED-DOWN HARVESTING EQUIPMENT, INSPECT THE BUNDLES FOR MISSING PARTS AND ASSEMBLE THE VARIOUS TYPES OF HARVESTING EQUIPMENT ACCORDING TO DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

2. PROVIDED VARIOUS TYPES OF ASSEMBLED HARVESTING EQUIPMENT, MAKE INITIAL ADJUSTMENTS ON THE EQUIPMENT AND PROVIDE PRE-DELIVERY SERVICE ACCORDING TO THE DIRECTIONS IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

3. PROVIDED VARIOUS TYPES OF ASSEMBLED HARVESTING EQUIPMENT, LOAD, DELIVER, AND UNLOAD ASSEMBLED HARVESTING EQUIPMENT AT THE PROPER CUSTOMER LOCATION WITH NO DAMAGE RESULTING TO THE ASSEMBLED EQUIPMENT.

4. PROVIDED VARIOUS TYPES OF MALFUNCTIONING HARVESTING EQUIPMENT IN NEED OF MINOR REPAIRS OR SERVICE, MAKE SUCH MINOR REPAIRS AND SERVICE ACCORDING TO DIRECTIONS DETAILED IN THE OPERATOR'S INSTRUCTIONAL MANUAL.

B. INSTRUCTIONAL AREAS

1. TYPES OF HARVESTING EQUIPMENT USED IN AGRICULTURE

   A. OPERATION OF VARIOUS TYPES OF HARVESTING EQUIPMENT SUCH AS:

      (1) MOWERS
      (2) RAKES
      (3) BALER
      (4) FORAGE CHOPPERS
      (5) COMBINES
      (6) CORN PICKERS
      (7) COTTON PICKERS
      (8) POTATO DIGGERS
      (9) HAY CONDITIONERS
      (10) WINDROWERS
      (11) FRUIT PICKERS
      (12) OTHER

B. FUNCTION OF VARIOUS COMPONENTS OF THE DIFFERENT TYPES OF HARVESTING EQUIPMENT

2. ASSEMBLING VARIOUS TYPES OF HARVESTING EQUIPMENT

A. CHECKING THE ASSEMBLY INSTRUCTIONS FOR ANY SPECIAL PROCEDURES OR TOOLS THAT MAY BE NEEDED

B. LOCATING THE BUNDLES, LAYING OUT THE BUNDLES WHERE THEY WILL BE CONVENIENT, AND OPENING THE BUNDLES

C. CHECKING THE PACKING LIST AGAINST THE PARTS IN THE BUNDLES

D. SEPARATING THE HARDWARE ITEMS INTO CONVENIENT PILES FOR IDENTIFICATION

E. FOLLOWING INSTRUCTIONS IN ASSEMBLING THE VARIOUS TYPES OF HARVESTING EQUIPMENT SUCH AS A SIDE DELIVERY RAKE

(1) ATTACHING THE SUB-FRAME TO THE BASKET FRAME
(2) ASSEMBLING THE AXLE, WHEELS, ARCH, AND JACK ASSEMBLY
(3) INSTALLING THE REAR BRACE AND IDLER SHEAVE ASSEMBLY
(4) ATTACHING THE TILT BRACKET, FRONT AND DIAGONAL BRACE AND LIFT ASSEMBLY
(5) INSTALLING THE LIFT CRANK
(6) ATTACHING THE BASKET TO THE MAIN FRAME
(7) INSTALLING THE RIGHT AND LEFT LIFT RODS
(8) INSTALLING THE BELT ON THE SHEAVES
(9) INSTALLING THE IDLER AND BELT SHIELD
(10) INSTALLING THE TEETH ON THE ONE BAR SHIPPED WITHOUT TEETH
(11) INSTALLING OPTIONAL EQUIPMENT SUCH AS A REMOTE CLUTCH CONTROL, HYDRAULIC CYLINDER CONTROL, DUAL WHEELS, AND GAUGE WHEEL
(12) CHECKING ALL BOLTS FOR TIGHTNESS AND TIGHTENING ANY BOLTS THAT ARE LOOSE

3. PRE-DELIVERY SERVICING OF VARIOUS TYPES OF HARVESTING EQUIPMENT SUCH AS A SIDE DELIVERY RAKE

A. CHECKING ALL PRESSURE FITTINGS WHEN THE RAKE IS ASSEMBLED AND REPLACING ANY DAMAGED FITTINGS

B. LUBRICATING THE SIDE DELIVERY RAKE AND CLEANING ANY CLOGGED FITTINGS

C. TESTING THE OPERATION OF THE RAKE FOR SMOOTH OPERATION AND PROPER ALIGNMENT

D. MAKING CHANGES AND ADJUSTMENTS IF NEEDED TO PROVIDE SMOOTH OPERATION

E. MAKING INITIAL ADJUSTMENTS ON THE SIDE DELIVERY RAKE

(1) ADJUSTING THE CLUTCH CLEARANCE SPACE WHEN THE CLUTCH IS IN GEAR TO THE MANUFACTURER'S SPECIFICATIONS
(2) INITIAL LEVELING OF THE BASKET BY ADJUSTING THE LIFT RODS
(3) INITIAL ADJUSTMENT FOR FLUFFY OR LOOSE WINDROWS
(4) INITIAL FRICTION BRAKE ADJUSTMENT FOR EXCESSIVE BOUNCE
(5) INITIAL ADJUSTMENT OF DRIVE BELT TO THE DEFLECTION SPECIFICATION OF THE MANUFACTURER.

4. DELIVERING VARIOUS TYPES OF HARVESTING EQUIPMENT TO THE CUSTOMER

A. LOADING THE SIDE DELIVERY RAKE ON THE TRUCK OR TRAILER OR ATTACHING THE RAKE TO A TRUCK FOR DELIVERY

B. CHAINING THE RAKE WHEN LOADED ON THE TRUCK TO ELIMINATE DAMAGE DUE TO SHIFTING WHILE TRAVELING

C. UNLOADING THE SIDE DELIVERY RAKE

D. GIVING THE CUSTOMER INSTRUCTIONS ON THE OPERATION AND MAINTENANCE OF THE SIDE DELIVERY RAKE

(1) EXPLAINING THE USE OF THE OPERATOR'S MANUAL
(2) EXPLAINING GENERAL OPERATION PROCEDURES FOR THE SIDE DELIVERY RAKE
(3) EXPLAINING GENERAL MAINTENANCE PROCEDURES FOR THE SIDE DELIVERY RAKE
(4) EXPLAINING HOW TO MAKE VARIOUS ADJUSTMENTS ON THE SIDE DELIVERY RAKE
(5) FILING THE DELIVERY REPORT

5. SERVICING AND/OR REPAIRING THE SIDE DELIVERY RAKE

A. IDENTIFYING SYMPTOMS THAT MAY INDICATE PROBLEMS IN THE RAKE AND THE CAUSE(S)

B. CORRECTING THE CAUSE(S) OF THE PROBLEMS

(1) REMOVING AND REPLACING TOOTH BAR BEARINGS
(2) REPLACING THE DRIVE BELT
(3) REPLACING THE TEETH ON THE RAKE
(4) ADJUSTING ENDPLAY ON REEL SHAFT
(5) INSPECTING FOR BENT OR BROKEN PARTS AND REPLACING BENT OR BROKEN PARTS

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. HAVE THE STUDENTS ATTACH THE BASKET OF A SIDE DELIVERY RAKE TO THE MAIN FRAME AND ATTACH THE BELT. THE STUDENTS WILL NEED TO REMOVE THE BOLTS HOLDING THE RIGHT ARCH CHANNEL AND SLIDE THE BELT OVER THE WHEEL AND BETWEEN THE CHANNEL SO IT CAN BE PLACED ON THE BELT PULLEY.

2. HAVE THE STUDENTS LEVEL THE BASKET ON A SIDE DELIVERY RAKE BY FOLLOWING PROCEDURES DESCRIBED IN THE OPERATOR'S INSTRUCTION MANUAL.

3. HAVE THE STUDENTS LOAD A SIDE DELIVERY RAKE ON A TRUCK FOR DELIVERY. THE STUDENTS SHOULD SECURE THE RAKE BY USING CHAINS AND BINDERS.

4. HAVE THE STUDENTS SERVICE AN OLDER RAKE IN NEED OF SERVICE. THE STUDENTS SHOULD REPLACE THE DRIVE BELT IF NECESSARY AND REPLACE THE TOOTH BAR BEARINGS BEING SURE TO PLACE A GOOD GRADE OF GREASE IN THE WELL OF THE BEARING AND REPLACE THE DUST CAP.

D. EXAMPLES OF PROCESSES TO EVALUATE STUDENT PERFORMANCE

1. DEVELOP A SKETCH WHICH SHOWS THE ASSEMBLY ON WHICH THE DRIVE BELT IS TO BE PLACED. HAVE THE STUDENTS USE A COLORED PENCIL TO DRAW THE PATH WHICH THE BELT SHOULD FOLLOW WHEN INSTALLED. EVALUATE THE STUDENTS RESPONSE FOR ACCURACY AGAINST THE SKETCH IN THE ASSEMBLY MANUAL WHICH SHOWS THE BELT INSTALLED.

2. USING AN ASSEMBLED SIDE DELIVERY RAKE, HAVE THE STUDENTS ADJUST THE DRIVE BELT TENSION SO THERE IS A 1 1/2" DEFLECTION IN THE BELT OR AS OTHERWISE RECOMMENDED BY THE MANUFACTURER.

3. HAVE THE STUDENTS CHAIN A SIDE DELIVERY RAKE ON A FLAT BED TRUCK. EVALUATE THE STUDENTS BY CONSIDERING THE DEGREE OF SLACK IN THE CHAIN(S) WHICH COULD CAUSE SHIFTING, THE PATH OF THE CHAIN AROUND THE RAKE, AND THE DEGREE OF STRESS ON PARTS OF THE RAKE WHICH MAY BECOME DAMAGED DUE TO CHAINING.

4. HAVE THE STUDENTS REMOVE AND REPLACE A TOOTH BAR BEARING AND SUBMIT ONE TOOTH BAR BEARING PER STUDENT FOR EVALUATION. EVALUATE THE STUDENT'S WORK BY CONSIDERING THE AMOUNT OF GREASE IN THE BEARING WELL AND THE AMOUNT OF BEARING GREASE BETWEEN THE BEARING AND CAP.

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. KNOCKED-DOWN HARVESTING EQUIPMENT FOR THE STUDENT TO WORK ON
2. SERVICE MANUALS AND OPERATOR'S MANUALS FOR THE STUDENTS TO USE
3. APPROPRIATE HAND TOOLS SUCH AS PLIERS, SCREWDRIVERS, HAMMERS, WRENCHES, SOCKET SETS, BLOCKING, CHAINS, BINDERS, AND HOISTS

F. EXAMPLES OF SUPPORTING REFERENCES

1. AGRICULTURAL MECHANICS - EQUIPMENT. COLLEGE STATION, TEXAS: DEPARTMENT OF AGRICULTURAL EDUCATION, TEXAS A & M UNIVERSITY. 1967, 500 PAGES.

   INCLUDED IN THEIR OUTLINE IS A BRIEF SUMMARY OF VARIOUS COMPONENTS OF CERTAIN HARVESTING EQUIPMENT.

2. MACHINES FOR MODERN FARMING. NEW YORK, NEW YORK: JOHN WILEY AND SONS, INC.

   THIS PUBLICATION WILL BE HELPFUL IN DISCUSSING THE OPERATION OF VARIOUS HARVESTING EQUIPMENT AND THE PURPOSE OF VARIOUS COMPONENTS OF THE HARVESTING EQUIPMENT.

3. SERVICE MANUALS AND ASSEMBLY MANUALS FOR THE HARVESTING EQUIPMENT BEING WORKED ON.

   THESE PUBLICATIONS WILL INCLUDE TECHNICAL INFORMATION NECESSARY FOR ASSEMBLING, ADJUSTING, REPAIRING, AND SERVICING HARVESTING EQUIPMENT.

APPENDIX A

RECOMMENDED MATERIALS OR EQUIPMENT

THIS LIST OF EQUIPMENT CAN BE USED AS A GUIDE IN ORDERING AND ASSEMBLING THOSE ITEMS NEEDED. MANY STATE DEPARTMENTS HAVE MORE DEFINITIVE LISTS AVAILABLE AND IT MAY BE WELL TO REQUEST THESE AS ADDITIONAL SOURCES OF INFORMATION. IN ADDITION, EXPERIENCE CAN BE AN IMPORTANT FACTOR IN DEVELOPING LISTS.

TOOLS, EQUIPMENT AND SUPPLIES FOR PROGRAMS IN AGRICULTURAL EQUIPMENT AND MECHANICS

DRILL PRESS - VARIABLE SPEED DRIVE
ARC WELDERS - 225 AMP. A.C.
CARBON ARC TORCH - OPTIONAL
ACETYLENE WELDER SETS - WITH TWO STAGE REGULATORS
OXYGEN TANKS
ACETYLENE TANKS
CYLINDER TRUCKS
STEAM JENNY
ELECTRIC ENGRAVING TOOL
CLUTCH ALIGNING TOOL
ARMATURE TESTER
AIR COMPRESSOR - 5 HP. 3 PHASE MOTOR AND ATTACHMENTS
COMPLETE SET SPRAY PAINTING EQUIPMENT
ELECTRIC DISC GRINDER
GRINDER - 10 IN. WHEELS
GRINDER - 6 IN. WHEELS
METAL CUTTING BAND SAW - OPTIONAL
TRACTOR DYNAMOMETER - 250 HP.
BATTERY CHARGER - 6 AND 12 VOLT
A FRAME HOIST
HYDRAULIC JACKS - 10 TON CAPACITY
ADJUSTABLE JACK STANDS
PARTS CLEANER TANK
COMPLETE VALVE SHOP
COMPRESSION TESTER - 14MM AND 18MM ADAPTERS
HYDRAULIC TESTER - INCLUDING HOSE ASSEMBLY AND ADAPTERS FOR VARIOUS TRACTORS
AIR IMPACT WRENCHES - ADJUSTABLE TORQUE INCLUDING SOCKETS
TIMING LIGHT
HIGH PRESSURE LUBRICATION GUN
GEAR LUBRICANT DISPENSER

TOOLS, EQUIPMENT AND SUPPLIES (CONTINUED)

LEVER TYPE GREASE GUN
OILERS - 1/2 PINT CAPACITY 5 IN. SPOUT
SPRING OILERS
SOCKET WRENCH SET - 3/4 IN. DRIVE
ELECTRIC SOLDERING GUN
ELECTRIC DRILL 3/8 IN. - REVERSIBLE
ELECTRIC DRILL 1/2 IN.
ASSORTED LIFTING EYE BOLTS AND S HOOKS
ASSORTED LUBRICATION FITTING DRIVES
ENGINE STAND
LOAD ROTOR - 4000 LB. CAPACITY
ANVIL - 150 LB., AND ACCESSORIES
TROUBLE LAMPS WITH EXTENSION CORD REEL - 3 WIRE
SET DRILL - 1/16 IN. TO 1/12 IN. BY 64THS
WIRE GAUGE DRILL BIT SET (0 - 60)
SET DRILLS - 9/16 IN. TO 1 IN. BY 16THS
CREEPERS
DRILLPRESS VISE
CENTER GAUGE
CRACK DETECTOR 3/4 IN. DRIVE (100-600 FT. LB.)
TORQUE WRENCH 1/2 IN. DRIVE
TORQUE WRENCH 3/8 IN. DRIVE (50-100 IN. LB.)
RETHREADER SET (NF AND NC 1/4 IN. - 1/2 IN.)
LO-LIFT TRANSMISSION JACK (CAPACITY 2,000 LBS.)
PISTON PIN PRESS SET
STEEL RULE
COMBINATION SQUARE - 12 IN.
DIAL INDICATOR
TAP AND DRILL GAUGE
RADIUS GAUGE
SCREW PITCH GAUGES
INSIDE MICROMETER
MICROMETER CALIPER - 0 TO 1 IN.
MICROMETER CALIPER - 1 TO 2 IN.
MICROMETER CALIPER - 2 TO 3 IN.
MICROMETER CALIPER - 3 TO 4 IN.
MICROMETER DEPTH GAUGE
PIPE WRENCHES
MACHINIST VISE - 5 IN. JAWS
MACHINIST VISE - 4 IN. JAWS
CROW BARS - 60 IN.
WRECKING BARS - 36 IN.
VISE GRIP WELDING CLAMPS
TUBE FLARING TOOL
TUBING CUTTER
VALVE SPRING COMPRESSOR
VALVE KEY REPLACER
TUBING BENDER - 1/4 IN. TO 5/8 IN.

TOOLS, EQUIPMENT AND SUPPLIES (CONTINUED)

CYLINDER HONE - 2 IN. TO 7 IN.
PISTON RING EXPANDER
RING GROOVE CLEANING TOOL
CYLINDER RIDGE REAMER
CYLINDER GAUGE - 1 3/4 IN. TO 3 1/4 IN.
CYLINDER GAUGE - 2 1/2 IN. TO 6 IN.
GRINDING WHEEL DRESSING TOOL
SET OF SCREW, STUD, PIPE, EXTRACTOR
SET OF TAPS AND DIES - 1/4 IN. TO 1 IN. NF AND NC
VALVE SPRING TESTER
MAGNETIC PIC-UP TOOL
INSIDE CALIPER - 4 IN.
INSIDE CALIPER - 6 IN.
INSIDE CALIPER - 8 IN.
OUTSIDE CALIPER - 4 IN.
OUTSIDE CALIPER - 6 IN.
OUTSIDE CALIPER - 8 IN.
WORK BENCHES AND VISES
SET OF INSTALLER PLATES
COMPLETE SET OF AIR CONDITIONING UNIT TOOLS
DIVIDERS - 4 IN.
DIVIDERS - 6 IN.
DIVIDERS - 8 IN.
VERNIER CALIPER
INJECTOR CLEANING KIT
LEVEL 18 IN. ALUMINUM
TIN SNIPS - 10 IN.
BOLT CUTTER - 18 IN.
BOLT CUTTER - 36 IN.
RETAINING RING PLIERS INTERNAL AND EXTERNAL
HOSE CLAMP PLIERS
VISE GRIP WRENCHES
PLASTIC MALLET - 2 LB.
BRASS HAMMER - 1 LB.
BRASS HAMMER - 1 1/2 LB.
INSPECTION MIRROR
GRIP-IT TOOL - 8 IN. FLEXIBLE
C CLAMPS - 6 IN.
C CLAMPS - 8 IN.
C CLAMPS - 12 IN.
I-BAR CLAMP - 6 FT.
SAFETY CANS - 5 GAL.
SAFETY CANS - 1 GAL.
OILY WASTE CAN - 6 GAL. CAPACITY
WELDING GOGGLES, ACETYLENE
WELDING HELMETS
SAFETY GOGGLES
BLACKSMITH TONG
SET OF TIP CLEANERS

TOOLS, EQUIPMENT AND SUPPLIES (CONTINUED)

PAINT BRUSHES - 1/2 IN.
PAINT BRUSHES - 1 IN.
PAINT BRUSHES - 2 IN.
PUTTY KNIVES - 2 1/8 IN. BLADE
PUTTY KNIVES - 5 IN. BLADE
CARBON SCRAPERS FLEXIBLE
CARBON SCRAPERS BENT
MISC. METAL FILES 6, 8, 10, 12 IN. MILL CUT
FILE HANDLES
PROTECTO FACE SHIELD
TERMINAL SERVICE KIT
LENGTHS AIR HOSE - 25 FT. WITH QUICK COUPLERS
AIR DUSTING GUNS
WATER HOSES - 50 FT. HEAVEY DUTY NEOPRESS
GEAR CASE CLEANER FLEXIBLE
CARBON BRUSH STANDARD
SET OF ADJUSTABLE REAMERS
FLARE NUT WRENCHES
METRIC SOCKET SET
CARBON BRUSH SPRIAL TWIST
CARBON BRUSH CUP
BATTERY HYDROMETER
BATTERY CARRIER
BATTERY TERMINAL CLEANING TOOL
BATTERY TERMINAL SPREADER
BATTERY BOOSTER CABLE
BATTERY CELL TESTER
BATTERY TERMINAL PULLER
CALIPER RULE WITH POCKET SLIDE
DEPTH GAUGE RULE
BATTERY SERVICE KIT
RADIATOR HYDROMETER
BRIGGS AND STRATTON SMALL ENGINE SERVICE KIT
RUBBER MALLETS
TACHOMETER
OIL MEASURE - 2 QT. CAPACITY
LEAD HAMMER - 2 LB.
OIL STONE - 1 IN. X 2 IN. X 6 IN.
WIRE BRUSHES
BROOMS - 24 IN. PURE HORSE HAIR
BALL PEIN HAMMER - 8 OZ.
BALL PEIN HAMMER - 16 OZ.
BALL PEIN HAMMER - 20 OZ.
BALL PEIN HAMMER - 24 OZ.
ENGINEER HAMMER - 40 OZ.
ENGINEER HAMMER - 48 OZ.
SLEDGE HAMMER - 6 LB.
SLEDGE HAMMER - 8 LB.
SLEDGE HAMMER - 12 LB.

TOOLS, EQUIPMENT AND SUPPLIES (CONTINUED)

HAMMER PLASTIC - 8 OZ.
WHEEL SLIDING TOOL
CLEVIS - TWISTED AND STRAIGHT
CHIPPING HAMMERS
COUNTER DUSTERS
SET LETTER STAMPS HARDENED FOR STEEL
EXTENSION CORDS - THREE WIRE # 12 WIRE
TIRE GAUGE - WET TYPE
SOCKET SETS OF VARIOUS SIZE DRIVE
SCREW STARTER
DIESEL NOZZLE CLEANING KIT
SET LAPPING BLOCKS
JAR LAPPING COMPOUND - 1/2 LB.
STEEL TAPE - 6 FT.
FUNNEL - LOCK ON
DRAIN PANS
OIL SEAL INSTALLATION KIT
MAIN BEARING REMOVER
POWER HACK SAW
HOLLOW PUNCH SET FOR GASKETS
LOG CHAINS - 12 TO 15 FT.
FLASHLIGHT
230 AMP. EXTENSION CORD FOR WELDER
WIRE WHEEL WITH STEM FOR DRILL
1/4 IN. PNEUMATIC DRILL
FLAT FLOOR SCRAPER
SQUEEGES TO CLEAN FLOOR
WELDING GLOVES
WELDER'S PROTECTIVE APRONS OR JACKETS
FIRST AID KITS
FIRE BLANKET
COMPLETE POP RIVET GUN SET
VOLT - AMP METER - MULTIMETER
MAGNETO TESTER SMALL ENGINE
COIL TESTER
VACCUM GAUGE
EXHAUST GAS ANALYZER (OPTINAL)
HELI COIL SET
UNIVERSAL CLUTCH DISK ALIGNING TOOL
BUSHING DRIVER SET
12 TON HYDRAULIC JACK
ASSORTMENT HYDRAULIC ADAPTORS
ELEVATED WASH RACK
PLASTIC CALIBRATION JARS (OPTIONAL)
BEARING PULLERS
PORTABLE TACHOMETER - REVOLUTION COUNTER WITH RUBBER ADAPTER TIPS

TOOLS, EQUIPMENT AND SUPPLIES (CONTINUED)

RADIATOR PRESSURE CAP TESTER
RADIATOR PRESSURE TESTER
SOLDERING IRON (ELECTRIC)
ALLEN WRENCH SETS
CHISEL AND PUNCH SETS
STANDARD TIP SCREW DRIVER SETS
PHILLIPS SCREW DRIVER SETS
IGNITION TOOL KITS
DEEP WELL SOCKET SET - 1/2 IN. DRIVE
PLIER SETS
ADJUSTABLE END WRENCH SET
VISE GRIP PLIER SET
OPEN END WRENCH SETS
GEAR AND PULLEY PULLERS
BOX END WRENCH SETS - 3/8 IN.-1 1/8 IN.
ROLL PIN REMOVAL PUNCH SET
COLD CHISEL - 1/4 IN. X 4 IN.
COLD CHISEL - 1/2 IN. X 6 IN.
COLD CHISEL - 7/8 IN. X 8 IN.
COLD CHISEL - 1 IN. X 8 IN.
CAPE CHISEL - 3/16 IN. X 4 IN.
CAPE CHISEL - 3/8 IN. X 6 IN.
HALF ROUND NOSE CHISEL - 3/16 IN. X 4 IN.
HALF ROUND NOSE CHISEL - 3/8 IN. X 6 IN.
DIAMOND POINT CHISEL - 3/16 IN. X 4 IN.
DIAMOND POINT CHISEL - 3/8 IN. X 4 IN.
ALIGNMENT PUNCHES - 3/16 IN. X 16 IN.
ALIGNMENT PUNCHES - 1/2 IN. X 18 IN.
DRIFT PUNCH (LONG TAPER) - 1/8 IN. X 10 IN.
DRIVE PUNCH (LONG TAPER) - 3/8 IN. X 10 IN.
STARTING PUNCH - 1/8 IN. X 5 IN.
STARTING PUNCH - 1/4 IN. X 6 IN.
PIN PUNCH - 1/8 IN. X 4 IN.
PIN PUNCH - 5/32 IN. X 5 IN.
PIN PUNCH - 3/16 IN. X 5 IN.
PIN PUNCH - 1/4 IN. X 6 IN.
CENTER PUNCH - 1/6 IN.
CENTER PUNCH 1/2 IN.
COMPLETE POP RIVET KIT

INDIVIDUAL STUDENT TOOL KITS WHICH INCLUDE THE FOLLOWING TOOLS:

CENTER PUNCH - 3/16 IN.
TAPER PUNCH - 1/4 IN.
PINCH BAR - 1/2 IN.
CAPE CHISEL - 5/16 IN.
CHANNEL LOCK PLIERS
COMBINATION PLIERS
NEEDLE NOSE PLIERS

INDIVIDUAL STUDENT TOOK KITS (CONTINUED)

IGNITION PLIERS
SCREW DRIVER
SPARK PLUG GAUGE
HACKSAW
IGNITION TOOL KIT
SOCKET SET - 1/2 IN. DRIVE 7/16 IN. TO 1 1/8 IN.
SET BOX END WRENCHES - 3/8 IN. TO 1 IN.
SET ALLEN WRENCHES
BALL PEIN HAMMER - 12 OZ.
COLD CHISEL - 7/8 IN. X 8 IN.
ADJUSTABLE END WRENCH - 8 IN.
ADJUSTABLE END WRENCH - 12 IN.
VISE GRIP PLIERS - 7 IN.
COMBINATION PLIERS - 7 IN.
DIAGONAL SIDE CUTTING PLIERS - 7 IN.
SCREW DRIVER - 1/4 IN. X 4 IN. STEEL SHANK THROUGH HANDLE
SCREW DRIVER - 3/8 IN. X 14 IN.
SCREW DRIVER - PHILLIPS # 1
SCREW DRIVER - PHILLIPS # 2
FEELER GAUGE - ETCHED NUMBERS
GASKET SCRAPER
ALIGNMENT PUNCH - 3/8 IN.-16 IN.
STEEL TAPE - 8 FT.
TOOL BOX

APPENDIX B

SUGGESTED REFERENCES FOR INSTRUCTIONAL UNITS

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APPENDIX C

SELECTED LIST OF PROFESSIONAL AND TECHNICAL SOCIETIES AND ORGANIZATIONS CONCERNED WITH AGRICULTURAL EQUIPMENT AND MECHANICS AND ITS APPLICATION

A SELECTED LIST OF PROFESSIONAL AND TECHNICAL SOCIETIES AND ASSOCIATIONS CONCERNED WITH AGRICULTURAL EQUIPMENT AND MECHANICS AND ITS APPLICATION CAN BE A HELPFUL SOURCE OF INSTRUCTIONAL INFORMATION AND REFERENCE DATA. THE COMPENDIUM WHICH FOLLOWS IS NOT A COMPLETE LISTING; INCLUSION OR OMISSION OF AN ORGANIZATION DOES NOT IMPLY APPROVAL OR DISAPPROVAL. THIS LISTING OMITS DETAILS REGARDING LOCAL CHAPTERS OR SECTIONS, BUT EDUCATORS MAY OBTAIN ADDITIONAL INFORMATION BY WRITING DIRECTLY TO THE EXECUTIVE SECRETARY OF ANY ORGANIZATION.

<ins>ALLIS CHALMERS MANUFACTURING COMPANY</ins>, FARM EQUIPMENT,
MILWAUKEE, WISCONSIN

<ins>AMERICAN ASSOCIATION FOR VOCATIONAL INSTRUCTIONAL MATERIALS</ins>,
COORDINATOR'S OFFICE, AGRICULTURAL ENGINEERING BUILDING,
UNIVERSITY OF GEORGIA, ATHENS, GEORGIA 30601

<ins>AMERICAN PETROLEUM INSTITUTE</ins>, C/O NEW YORK PETROLEUM COUNCIL, 757 THIRD AVENUE, NEW YORK, NEW YORK 10017

<ins>AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS</ins> (ASAE), 1950
NILES ROAD, ST. JOSEPH, MICHIGAN 49085

<ins>AMERICAN TECHNICAL EDUCATION ASSOCIATION, INC</ins>. (ATEA),
22 OAKWOOD PLACE, DELMAR, NEW YORK 12054

<ins>AMERICAN WELDING SOCIETY</ins> (AWS), 345 EAST 47TH STREET,
NEW YORK, NEW YORK 10000

<ins>AUTOLITE-FORD PARTS DIVISION</ins>, NATIONAL SERVICE DEPARTMENT,
P.O. BOX 3000, LIVONIA, MICHIGAN 48151

<ins>AUTOMOTIVE ELECTRICAL ASSOCIATION</ins> (AEA), 17223 MEYERS,
DETROIT, MICHIGAN 48325

<ins>AVCO NEW IDEA FARM EQUIPMENT DIVISION</ins>, PUBLIC RELATIONS
DEPARTMENT, COLDWATER, OHIO 45828

<ins>THE BLACK AND DECKER MANUFACTURING COMPANY</ins>, PUBLIC RELATIONS
DEPARTMENT, TOWSON, MARYLAND 21204

BRIGGS AND STRATTON CORPORATION, P.O. BOX 702, MILWAUKEE, WISCONSIN 53201

BROWN AND SHARPE MANUFACTURING COMPANY, INDUSTRIAL PRODUCTS DIVISION, PRECISION PARK, NORTH KINGSTOWN, RHODE ISLAND 02852

DAVID BROWN TRACTORS, C/O NORTHEAST TRACTOR COMPANY, ROUTE 68, HUBBARDSTON, MASSACHUSETTS 01452

J. I. CASE COMPANY, 6486 RIDINGS ROAD, INDUSTRIAL PARK, P.O. BOX 1096, SYRACUSE, NEW YORK 13200

CATERPILLAR TRACTOR COMPANY, SERVICE TRAINING DIVISION, 600 W. WASHINGTON, EAST PEORIA, ILLINOIS 61611

CHAMPION SPARK PLUG COMPANY, SCHOOL AID SECTION, P.O. BOX 910, TOLEDO, OHIO 43601

CUMMINS ENGINE COMPANY, INC., 1000 FIFTH STREET, COLUMBUS, INDIANA 47201

DANA CORPORATION, SCHOOL ASSISTANCE PROGRAM, HAGERSTOWN, INDIANA 47346

JOHN DEERE SERVICE PUBLICATIONS, JOHN DEERE ROAD, MOLINE, ILLINOIS 61265

DELCO-REMY, TECHNICAL LITERATURE DEPARTMENT, DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA 46011

DEVILBISS COMPANY, DIVISION OF CHAMPION SPARK PLUG, 300 PHILLIPS AVENUE, P.O. BOX 913, TOLEDO, OHIO 43692

DIESEL ENGINE MANUFACTURERS' ASSOCIATION (DEMA), 122 EAST 42ND STREET, NEW YORK, NEW YORK 10017

ESB BRANDS, INC., 2000 EAST OHIO BUILDING, P.O. BOX 6949, CLEVELAND, OHIO 44010

ETHYL CORPORATION, PETROLEUM CHEMICALS DIVISION, 1000 CHAMBER OF COMMERCE BUILDING, HOUSTON, TEXAS 77000

FARM AND INDUSTRIAL EQUIPMENT INSTITUTE (FIEI), 410 NORTH MICHIGAN AVENUE, CHICAGO, ILLINOIS 60611

FARM EQUIPMENT MANUFACTURERS' ASSOCIATION (FEMA), 230 SOUTH BEMISTON, ST. LOUIS, MISSOURI 63105

FORD TRACTOR OPERATIONS, 2500 EAST MAPLE ROAD, TROY, MICHIGAN 48084

IGNITION MANUFACTURERS' INSTITUTE, 1008 STANDARD BUILDING, CLEVELAND, OHIO 44113

INTERNATIONAL HARVESTER COMPANY, 401 NORTH MICHIGAN AVENUE, CHICAGO, ILLINOIS 60611

JACOBSEN MANUFACTURING COMPANY, 1721 PACKARD AVENUE, RACINE, WISCONSIN 53403

KOHLER COMPANY, KOHLER, WISCONSIN 53044

LAWN-BOY, A DIVISION OF OUTBOARD MARINE CORPORATION, GALESBURG, ILLINOIS 61401

LINCOLN ARC WELDING FOUNDATION, P.O. BOX 3035, CLEVELAND, OHIO 44117

MASSEY-FERGUSON, LTD., TORONTO, ONTARIO, CANADA

MILLERS FALLS COMPANY, EDUCATIONAL FILM DEPARTMENT, GREENFIELD, MASSACHUSETTS 01301

NATIONAL FARM AND POWER EQUIPMENT DEALERS ASSOCIATION (NFPEDA), 2340 HAMPTON AVENUE, ST. LOUIS, MISSOURI 63139

STATE, REGIONAL AND PROVINCIAL ASSOCIATIONS AFFILIATED WITH THE NATIONAL FARM AND POWER EQUIPMENT DEALERS ASSOCIATION:

1. ALABAMA FARM EQUIPMENT ASSOCIATION
2. CALIFORNIA EQUIPMENT DEALERS' ASSOCIATION
3. CAROLINAS FARM AND POWER EQUIPMENT DEALERS' ASSOCIATION
4. DEEP SOUTH FARM AND POWER EQUIPMENT ASSOCIATION
5. FLORIDA RETAIL FARM AND POWER EQUIPMENT ASSOCIATION
6. GEORGIA FARM EQUIPMENT ASSOCIATION
7. ILLINOIS RETAIL FARM EQUIPMENT ASSOCIATION
8. INDIANA IMPLEMENT DEALERS' ASSOCIATION
9. INTERMOUNTAIN ASSOCIATION, HARDWARE AND IMPLEMENT DEALERS
10. IOWA RETAIL FARM EQUIPMENT ASSOCIATION
11. KENTUCKY RETAIL FARM EQUIPMENT ASSOCIATION
12. MAR-DEL-VA FARM EQUIPMENT ASSOCIATION
13. MICHIGAN FARM AND POWER EQUIPMENT ASSOCIATION
14. MID-SOUTH FARM EQUIPMENT ASSOCIATION
15. MID-WEST RETAIL FARM EQUIPMENT ASSOCIATION
16. RETAIL FARM EQUIPMENT ASSOCIATION OF MINNESOTA AND SOUTH DAKOTA
17. MISSISSIPPI VALLEY FARM EQUIPMENT ASSOCIATION

18. MONTANA HARDWARE AND IMPLEMENT ASSOCIATION
19. MOUNTAIN STATES HARDWARE AND IMPLEMENT ASSOCIATION
20. NEW ENGLAND FARM AND POWER EQUIPMENT DEALERS ASSOCIATION
21. NEW JERSEY LAWN, INDUSTRIAL AND FARM EQUIPMENT ASSOCIATION
22. NEW YORK FARM EQUIPMENT DEALERS' ASSOCIATION
23. NORTH DAKOTA IMPLEMENT DEALERS' ASSOCIATION
24. FARM AND POWER EQUIPMENT RETAILERS OF OHIO
25. OKLAHOMA HARDWARE AND IMPLEMENT ASSOCIATION
26. PACIFIC NORTHWEST HARDWARE AND IMPLEMENT ASSOCIATION
27. PENNSYLVANIA RETAIL FARM AND INDUSTRIAL EQUIPMENT ASSOCIATION
28. SASKATCHEWAN IMPLEMENT DEALERS' ASSOCIATION
29. TEXAS HARDWARE AND IMPLEMENT ASSOCIATION
30. TRI-STATE HARDWARE AND IMPLEMENT ASSOCIATION
31. VIRGINIA FARM EQUIPMENT ASSOCIATION
32. WESTERN RETAIL IMPLEMENT AND HARDWARE ASSOCIATION
33. WISCONSIN IMPLEMENT DEALERS' ASSOCIATION

NATIONAL FLUID POWER ASSOCIATION (NFPA), BOX 49, THIENSVILLE, WISCONSIN 53092

NATIONAL SAFETY COUNCIL, 425 NORTH MICHIGAN AVENUE, CHICAGO, ILLINOIS 60600

NICHOLSON FILE COMPANY, ADVERTISING DEPARTMENT, PROVIDENCE, RHODE ISLAND 02901

C. E. NIEHOFF AND COMPANY, 4925 LAWRENCE AVENUE, CHICAGO, ILLINOIS 60630

ONAN, 1400 73RD AVENUE N.E., MINNEAPOLIS, MINNESOTA 55432

OLIVER CORPORATION, CHICAGO, ILLINOIS

OUTDOOR POWER EQUIPMENT INSTITUTE, INC., WALKER BUILDING, WASHINGTON, D.C. 20005

ROCKWELL, EDUCATIONAL DEPARTMENT, POWER TOOL DIVISION, 400 NORTH LEXINGTON AVENUE, PITTSBURG, PENNSYLVANIA 15208

SEARS, ROEBUCK AND COMPANY, STAFF OFFICES, DEPARTMENT 731 A, 925 S. HOMAN AVENUE, CHICAGO, ILLINOIS 60607

SIOUX TOOLS, INC., 2802 FLOYD BOULEVARD, SIOUX CITY, IOWA 51102

SMITH WELDING EQUIPMENT, DIVISION OF TESCOM CORPORATION, 2633 SOUTH EAST 4TH STREET, MINNEAPOLIS, MINNESOTA 55414

STANLEY TOOLS, EDUCATIONAL DEPARTMENT, P.O. BOX 1800,
NEW BRITAIN, CONNECTICUT 06050

THE L. S. STARRET COMPANY, ATHOL, MASSACHUSETTS 01331

TECUMSEH PRODUCTS COMPANY, PARTS DEPOT DIVISION, GRAFTON,
WISCONSIN 53024

TELEDYNE WISCONSIN MOTOR, 1910 SOUTH 53RD STREET, MILWAUKEE,
WISCONSIN 53246

TIMKEN ROLLER BEARING COMPANY, 1835 DUEBER AVENUE S.W.,
CANTON, OHIO 44706

UNION CARBIDE CORPORATION, CONSUMER PRODUCTS DIVISION,
270 PARK AVENUE, NEW YORK, NEW YORK 10017

VICKERS DIVISION OF SPERRY RAND CORPORATION, P.O. BOX 302,
TROY, MICHIGAN 48084

VISUAL EDUCATION, INC., SUITE 819-SOUTHERN BUILDING, 1425
H STREET, N.W., WASHINGTON, D.C. 20005

WHITE FARM EQUIPMENT (OLIVER), 300 LAWLER STREET, CHARLES
CITY, IOWA 50616

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